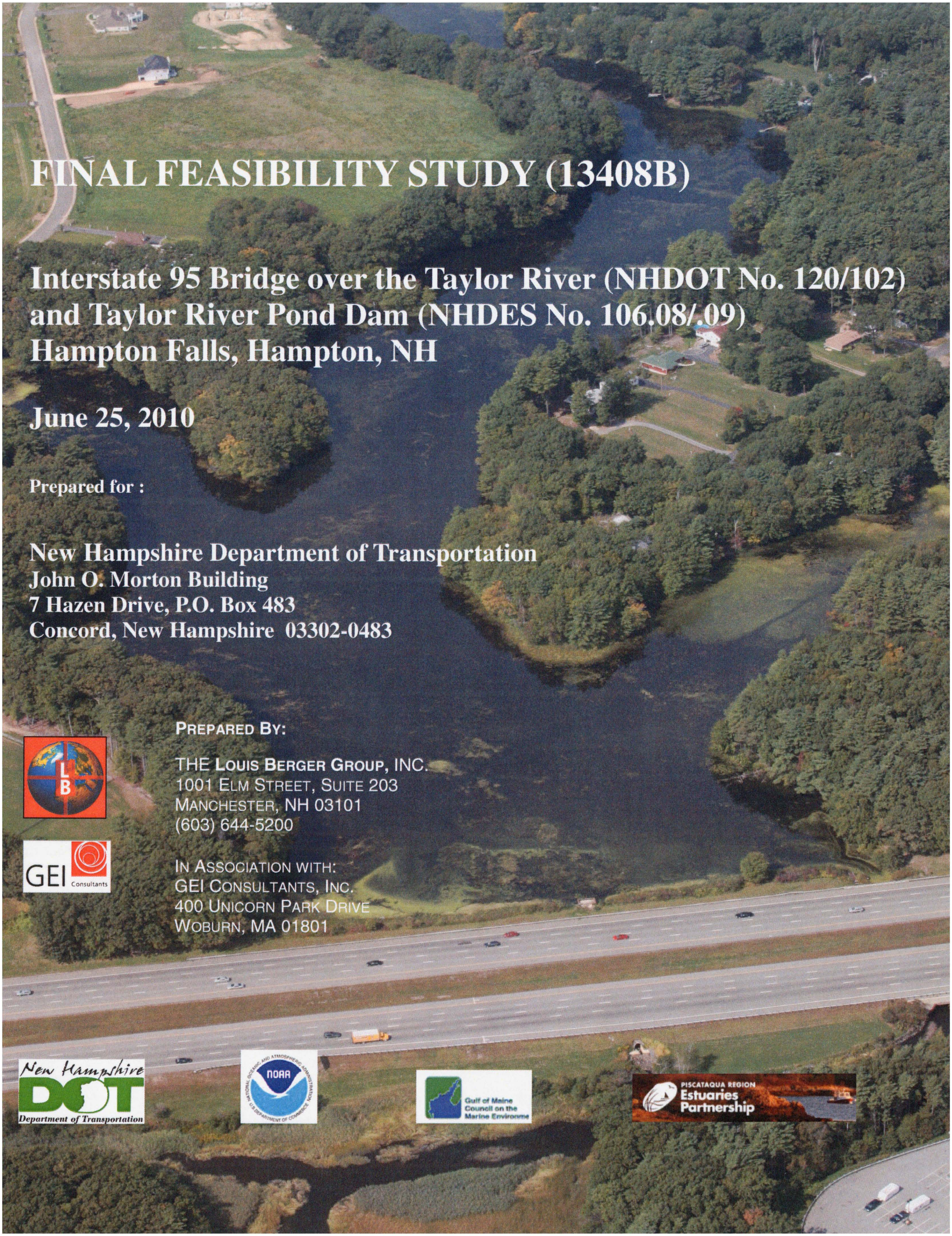

FINAL FEASIBILITY STUDY (13408B)

Interstate 95 Bridge over the Taylor River (NHDOT No. 120/102) and Taylor River Pond Dam (NHDES No. 106.08/.09) Hampton Falls, Hampton, NH

June 25, 2010

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Piscataqua Region Estuaries Partnership

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ADDITIONAL DATA CD

1.0 BACKGROUND

1.1 Introduction

The Taylor River Pond is located in Hampton Falls and Hampton, NH, just south of the Interstate 95 (I-95) Rest Area and Liquor Store (**Figure 1**). The pond was created by a dam. The earthen embankment of the dam is crossed by Interstate I-95. Taylor River flows out of the pond via a primary spillway (NHDES Dam No. 106.08) into the downstream estuary. The outflow via the spillway is crossed by a bridge (NHDOT Bridge No. 120/102). The I-95 bridge and the primary spillway have deteriorated and require repair.


Taylor River Pond Primary Spillway/ Fishway and I-95 Bridge

In addition to the primary spillway, an emergency spillway exists further south (NHDES Dam No. 106.09). This structure includes a culvert through the earthen embankment. Reportedly the culvert attracts migrating fish during high flows. However, when the high flow recedes, the fish get stranded either immediately below the emergency spillway or within the culvert.

Collectively, the primary spillway, emergency spillway and culvert, and earthen embankment are hereafter referred to as the “Taylor River Pond Dam” or the “Dam”.

The Louis Berger Group, Inc. (Berger) was retained by the New Hampshire Department of Transportation (NHDOT) to evaluate the feasibility of replacing the I-95 bridge, and removing or replacing the Taylor River Pond primary spillway, fishway, and emergency spillway/culvert.

1.2 Project Purpose and Goals

This Feasibility Study examined different alternatives for replacing the bridge, and removing or replacing the primary spillway, fishway, and emergency spillway/culvert. The assessment considered transportation, public safety, flood management, water quality, natural and cultural resources, and socioeconomic issues. The Feasibility Study also reviewed several options to restore anadromous fish[1] passage within the affected portion of the Taylor River.


Upstream face of I-95 Bridge

NHDOT indicated that addressing the concerns with the I-95 bridge over the Taylor River is a high priority. The steel sheet-piling wall that supports the reinforced concrete slab bridge is exposed to a corrosive saltwater tidal environment and is heavily rusted. The reinforced concrete slab is also showing signs of deterioration with cracks and spalls.

[1] Anadromous fish are species that live most of their lives in the ocean and return to freshwater to spawn.

The Feasibility Study was based on a review of relevant existing information, collection of additional information in the field and from other sources, and a synthesis of the information for the development of a viable solution for the deteriorated structures.

Specifically, the Feasibility Study included the following components:

- Hydraulic/hydrologic analysis of the Taylor River;
- Fluvial geomorphology;
- Sediment analysis;
- Structural engineering design for the Dam and bridge;
- Bathymetric (depth) measurement in the Taylor River Pond;
- Aquatic/fisheries resources assessment;
- Wetland delineation adjacent to I-95;
- Water quality assessment;
- Socio-economic assessment;
- Recreational use assessment; and
- Archaeological and historical assessments.

This Feasibility Study was completed in conjunction with the NHDOT, NH Department of Environmental Services (NHDES), the Towns of Hampton and Hampton Falls, the NH Fish and Game Department (NHFGD), the National Oceanic and Atmospheric Administration (NOAA) Restoration Center, the U.S. Fish and Wildlife Service (USFWS), American Rivers, and the Piscataqua Regional Estuaries Partnership (PREP). Funding for this study was provided by NHDOT, NOAA, Gulf of Maine Council on the Maine Environment, and the PREP. This group is also referred to as the "Project Partners".

1.3 Taylor River and its Watershed

The watershed boundary of the Taylor River is presented in **Figure 2**. The headwaters of the river start just south of Lamprey Road near the common corporate boundary of Kensington, Hampton Falls, and South Hampton, NH. The river first generally flows south to north through Kensington, then turns northwesterly to southeasterly through the Towns of Hampton Falls and Hampton. It continues underneath I-95 and US Route 1, through the "Hampton Flats" estuary, and finally into the Atlantic Ocean in Hampton.

Several smaller tributaries discharge into the Taylor River, including Grapevine Run and Clay Brook (from the southwest), Old River (from the northeast), and Ash Brook (from the northwest). The Taylor River Pond Dam creates an impoundment that extends approximately 2 miles upstream from I-95 to Old Stage Road. The total watershed area above the Taylor River Pond Dam (upstream from I-95) is estimated to be 7,075 acres.

Three other dams upstream of the Taylor River Pond are on record in the NHDES database:

1. <u>Rice Dam</u> (#106.06): Located just upstream of Old Stage Road, in Hampton, NH.
2. <u>Car Barn Pond Dam</u> (#105.01): Located south of Hampton Road/NH Route 27 on the Old River, in Hampton Falls, NH.

3. Proposed "Taylor River Dam" (#106.13): Located just south (upstream) of Curtis Road on the upper Taylor River, in Kensington, NH. This dam was not built. However, according to NHDES records, existing remains of a former dam, referenced as an "Old Stone Dam", are located at this location, and are included in the NHDES evaluation of the Taylor River Pond Dam.

These upstream dams were included and analyzed by the NHDES Dam Bureau. Measurements and storage information as provided in the NHDES documents were used in the analysis, as described in subsequent sections of this Feasibility Study.

The Taylor River Pond supports spawning of anadromous river herring (blueback herring and alewife) and contains resident freshwater fish species. American eel elvers (juvenile form of this catadromous species[2]) also ascend the Taylor River into the pond.


Normal High Tide Downstream of Taylor River Pond Dam

The river is not listed as a "designated river" under NH Statue RSA 483.10. However, upstream of the Dam, Taylor River is listed by the USEPA (under the Clean Water Act Section 303[d] list) as being impaired for mercury. Downstream of the Dam, the large Taylor River tidal estuary is listed on the 303(d) list as impaired for polychlorinated biphenyls (PCBs), dioxin, and fecal coliform (USEPA, 2009).

1.4 Existing Structures

The base plan developed for this Feasibility Study is presented in **Figures 3** to **6**. The plan shows the existing structures. Data used for the development of the plan consisted of the following:

- Field survey data (Fall 2006): Obtained by the NHDOT from the Rice Dam downstream to the I-95/Taylor River Pond Dam.
- Aerial survey data (Fall 2005): Obtained by Col-East, Inc. for the Taylor River Pond and surrounding area. This data developed in accordance with NHDOT Mapping Standards for use with Microstation/MX. A digital terrain model was developed and 2-foot contours were generated. Digital orthophotos were provided with a pixel size of 0.5 foot.
- Bathymetry survey data (October 2006): Bathymetric contours of Taylor River Pond were developed by HydroTerra based upon soundings collected from October 6 to 14, 2006. The vertical datum was NHDOT HT-2 at 2.78 feet NGVD 1929 at Towle Farm Road. Details of the bathymetry survey are included in **Appendix A**.


Downstream Face of I-95 Bridge

All elevations in this Feasibility Study are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29), as this is the datum of the base plans and reference documents used.

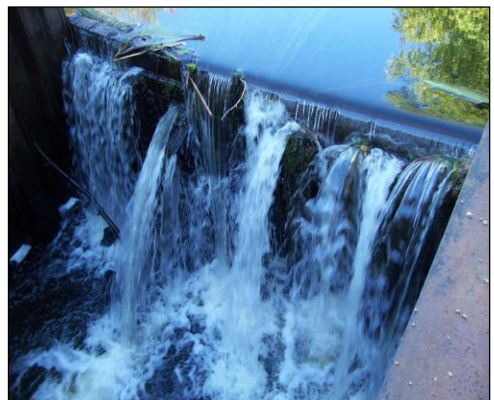
[2] Catadromous species live most of their lives in freshwater and return to the ocean to spawn.

1.4.1 I-95 Bridge

The existing I-95 bridge (Bridge No. 120/102) was originally constructed in 1950 as part of Taylor River Structure No. 5, and was later extended in 1974 as part of a roadway widening for the I-95 Northbound barrel. It currently carries the eight lanes of I-95 over the Taylor River. Upon review of historic US Geological Survey (USGS) plans and review of the original NHDOT design plans for the existing bridge, it is evident that the existing bridge was constructed to the north of the original Taylor River channel. A new, approximately 380-foot-long tidal channel (ranging from 6 to 13 feet deep) was excavated for the bridge to connect Taylor River to the original channel located further to the southeast.

The existing bridge structure is approximately 207 feet long (measured along the relocated Taylor River) and provides a clear opening width of 15 feet. It is comprised of vertical steel sheet piling supporting a cast-in-place reinforced concrete slab and approximately six to eight feet of roadway fill. The NHDOT Bridge Inspection Reports note that the steel sheet piling is heavily rusted with section loss and holes below the waterline. The reinforced concrete slab shows cracking and spalling, and is leaking. The bridge rail, rail transition and approach rail ends do not meet current standards.

1.4.2 Primary Spillway and Associated Structures


Primary Spillway

The primary spillway was constructed in 1950 as part of the I-95 highway bridge over the Taylor River near head-of-tide in Hampton, NH, as waterfowl mitigation requested by the NHFGD. A Denil fishway[3] was installed on the primary spillway in the late 1960s to provide anadromous fish passage. According to the 1948 construction plans, the existing primary spillway was constructed approximately 535 feet north of the historical river channel that divides the Towns of Hampton and Hampton Falls. The total embankment length is estimated to be between 600 and 650 feet. An approximately 180-foot-long channel was also constructed from the existing bridge on the east side of I-95, to the existing tidal channel. According to information from the NHDOT and the NHDES Dam Safety Bureau, and as observed during the September 26, 2006 inspection, the primary spillway, the emergency spillway/culvert, and the fishway have since begun to deteriorate. The deteriorated fishway has resulted in less efficient fish passage.

According to NHDOT and NHDES information and inspections (NHDES November 2004 hydrologic evaluation, January 12, 2005, meeting notes, and January 25, 2005, inspection report, included in **Appendix B**), there are four major components associated with fish passage and access to upstream habitat, as follows:

1. Primary Spillway (NHDES Dam #106.08): The NHDOT-owned primary spillway is 18.5 feet tall and 50 feet long (embankment to embankment), and blocks fish access to upstream habitat, although this is somewhat mitigated by the existing fishway. The 15.2-foot-wide sheet pile primary spillway and 3-foot-high flashboard bay are deteriorating, with numerous leaks and holes. The top of the sheet pile spillway is at elevation 7.54 feet. The timber flashboards were installed on top of the sheet pile

[3] A Denil fishway is designed with a series of sloped channels and can be constructed with an overall slope of 10 to 25 percent. It contains wooden baffles that are positioned at regular intervals. The fishway has a narrow entrance which creates high water velocity to attract fish. It may also contain resting pools between long segments of the fishway.

spillway to an elevation of 8.55 feet, which is considered the elevation for "normal operation" of the primary spillway.

The I-95 earthen embankment that forms the main part of the Dam is in excellent condition, with a very wide crest, gentle slopes, and no apparent seepage from the downstream slope.

NHDES has recently re-evaluated the Dam and has classified the primary spillway as a "High Hazard Dam", *i.e.*, a dam that has "high hazard potential", as its failure may cause damage to an interstate highway, in accordance with NHDES Env-Wr 101.09(c). As stated in our January 2007 Technical Memorandum, the sheet pile primary spillway and flashboard bay are badly deteriorated, and settlement has been noted at the left abutment adjacent to the sheet pile training wall of the primary spillway. NHDOT owns and manages the Dam and has stated that the primary spillway should be removed or replaced. Repair of the existing primary spillway is not a viable option because this would not address concerns by local residents about flooding of the pond during peak storm events.

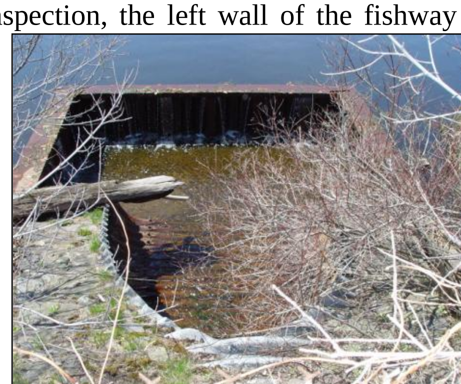
2. Impoundment: The Taylor River Pond Dam has created a freshwater pond covering an area of approximate 47.5 acres. The pond provides spawning and nursery habitat for anadromous and freshwater fish, and nursery habitat for catadromous American eel. There is an approximately 150-foot-long section of free-flowing stream between the Old Stage Road bridge and Rice Dam, based on Berger's September 2006 inspection. This short stream segment may also provide spawning habitat for river herring and nursery habitat for American eel.


Taylor River Pond, as seen from the Dam

A bathymetry survey of the impoundment recorded an average depth of 2 feet within nearshore areas and approximately 9 feet within the confined former channel.

According to two residents that were interviewed, the sediment gives off an odor when the lake level is very low.

3. Fishway: The existing 3-foot-wide Denil fishway was installed in the 1960s. It is currently in poor condition. It has leaks and holes where it is joined to the primary spillway. As stated in the January 2007 memo and according to the July 2, 2004 NHDES inspection, the left wall of the fishway is cracking. Water from the leaks and holes in the fishway attract and confuse migrating fish so that they may be unable to find the entrance to the fishway. The NHFGD operates the fishway and controls water levels in the fishway by using timber stop logs.


Emergency Spillway and Entrance to Culvert

4. Emergency Spillway/Culvert (NHDES Dam #106.09): The Taylor River Pond emergency spillway is a 35.5 foot long by 1.5-foot-wide sheet pile structure with a spillway elevation of 9.03 feet that flows into a 6.1-foot-high by 8.8-foot-wide steel plate pipe-arch culvert. The pipe-arch culvert carries excess water under the I-95 roadway south of the bridge and spillway location. As stated above,

discharge through this culvert attracts migrating fish during high flows. However, fish are stranded either immediately below the emergency spillway or in the culvert when the water level recedes. This spillway is considered a "Significant Hazard Dam" by the NHDES Dam Safety Bureau. A new concrete invert was recently constructed as a measure to repair the deteriorated culvert invert. The interior dimensions were reduced to a height of 5.66 feet and a width of 7.98 feet.

1.4.3 Dam and Fishway Maintenance

The NHDOT is listed as the owner of the Taylor River Pond Dam and has repaired the emergency spillway pipe-arch culvert, as mentioned above. The areas next to I-95 and the earthen embankment are cleared, mowed, and maintained frequently by the NHDOT Turnpike Division. However, according to the NHDOT Highway Division, no other regular maintenance of the structures is performed.

The NHFGD and NHDES maintain the water level of the pond using the existing timber flashboards at the primary spillway. The following is a summary of monitoring and maintenance procedures for the fishway as provided by NHFGD personnel:

- The fishway is monitored and maintained seven days per week, from the end of April through mid/late-June. A 10-minute calibration count is performed on the Smith-Root electronic fish counter to confirm that it is working properly. Once a week the battery in the fish counter within the fishway is changed. River herring are very sensitive to the amount of water flowing through the counting tube, so it is often adjusted as water levels rise/fall. According to the NHFGD, this watershed is very reactive to rain events and rises/falls very erratically. Each day the interior grates of the fishway are cleaned and logs/debris within or against the fishway or spillway are removed.

- Biological samples are taken three times during the spawning run (beginning, middle, and end). The NHFGD attempts to take 150 samples during each event. The Taylor River Pond Dam fishway does not have a trap at the top to hold fish. Therefore, samples must be taken from inside of the fishway using a dip net to catch river herring from between the baffles. This effort requires 2 or 3 people. Usually only 10 to 30 fish are captured each day for sampling. It usually takes many days to complete the sampling.

- Repairs are often made to the wooden structures within the fishway. Each year ice, debris, or rodents damage at least a few baffles. Also, the system of chutes, grates, and boards needed for fish passage periodically need maintenance or replacement. Periodic patching and caulking of the concrete part of the fishway is also required (about every 5 to 7 years). The steel grates on top of the fishway also need periodic replacement, requiring new mounting hardware drilled and hammered into the concrete.

- The fishway is damaged by vandals on an annual basis, mostly when the impoundment level is low. Typically, the lock/chain is cut and boards that allow fish passage are stolen or thrown downstream. Wooden boards or accumulated debris may result in blockage of the fishway. The materials that are damaged or lost are immediately replaced by NHFGD so that the river herring run can continue.

1.4.4 Flooding and Tides

The water elevation in Taylor River Pond is affected by high stormwater runoff volumes and high tidal elevations. In addition, strong persistent wind from the sea can push up tidal waters even further during high tide. The mean high water elevation of Hampton Harbor is 8.63 feet (Town of Hampton, 2009).

Flooding during the May 14 and 15, 2006, storm event ("Mother's Day Flood of 2006") was reported by residents located in the Taylor River Estates development northwest of the existing Dam. According to Mr. Frank Chamberlain (6 Laurel Drive, Taylor River Estates), flood elevations reached approximately 1.5 feet above his first floor. The water started to rise around 8:00 pm on May 14^{th}, reaching its peak in Taylor River Pond around midnight. The midnight peak elevation was likely affected by the high tide at that time (**Figure 7**), slowing the water release from the pond. The water receded later during the night and was low again by 8:00 am on May 15.

During the peak elevation around midnight, water reportedly inundated the two southbound lanes of I-95 by approximately 0.5 foot. This inundation marks the peak elevation of the Taylor River Pond for that flood event. Debris blocking the primary spillway and its downstream channel may have also affected the flood elevation.

2.0 ALTERNATIVES

2.1 Introduction

Berger and its sub-consultant, GEI Consultants, Inc. (GEI) analyzed the following three alternatives:

A. No Action

B. Replacement of I-95 bridge and new spillway/fishway

C. I-95 bridge replacement without spillway.

Issues addressed included the following:

- Effective fish passage (specifically American eel, river herring, and rainbow smelt);
- Rare, threatened, and endangered species located both up- and downstream of the project area;
- Water and sediment quality;
- Fire water supply and water wells for the area surrounding the Taylor River Pond;
- Cultural and historical resources;
- Recreational usage of Taylor River Pond; and
- Other socio-economic issues, including but not limited to, property values that may result from the removal or replacement of Taylor River Pond spillway Dam.

Rehabilitation of the spillway structures was not studied because it would not mitigate the flooding problem of the pond. Also, due to historic upstream flooding of the pond, a larger hydraulic bridge opening was to be analyzed.

Hydraulic analyses of Taylor River were performed for each alternatives. The HydroCAD® v 8.0 by HydroCAD Software Solutions, LLC software was used to analyze the existing spillways. The U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center's River Analysis System (HEC-RAS) hydraulic modeling software (version 3.1.3) was used to model the bridge alternatives with and without a spillway. Section 3.0 of this document contains further explanation of the analysis and results.

2.2 Alternative A: No Action

The alternative of not improving or replacing the existing I-95 bridge and spillway was considered. As stated above, the existing I-95 bridge, Taylor River Pond spillways and fishway are deteriorating. Fish passage efficiency is reduced, and some fish are trapped in the emergency spillway culvert following high flows. As the spillways are considered "high hazards", their failure may cause damage to the interstate highway and adversely impact many of the evaluated resources. Also, debris from a failed spillway could block the pond outlets underneath I-95, causing flooding of surrounding properties and/or I-95. The No-Action Alternative also does not address the flooding issues associated with the I-95 bridge and the Taylor River Pond spillway(s). This alternative is considered the baseline against which the other alternatives were compared.

2.3 Alternative B: Replacement of I-95 Bridge and New Spillway/ Fishway

This alternative consists of the removal of the existing bridge, primary spillway and emergency spillway/culvert. A new opening in the earthen embankment for a new 70-foot-long bridge with a 50-foot-wide spillway (at EL 8.55 feet) and a new fishway (appropriate for the species of concern) would be constructed southerly of the existing location, near the Hampton/Hampton Falls town line.

2.3.1 Proposed Bridge

Under both Alternatives B and C, the existing I-95 bridge would be replaced with a new concrete bridge. Several bridge alternatives were analyzed: a 90-foot-long (abutment to abutment) bridge opening with a 45-foot-wide channel; and an 85-foot-long and a 70-foot-long (abutment to abutment) bridge opening each with a 25-foot-wide channel. The 85-foot-long bridge was evaluated to determine if it was worthwhile to expand the bridge opening to allow for an increase in hydraulic capacity, and still maintain a similar bridge deck depth as the 70-foot-long bridge.

The 70-foot-long and 85-foot-long bridge lengths were evaluated with and without a proposed spillway. Hydraulic analyses were performed to model the channel flow area blocked to the High Monthly Tide (or "spring") surge elevation (EL 7.21 feet) as a downstream boundary condition, in combination with the 100-year freshwater storm (per the Federal Emergency Management Agency (FEMA) records). The flow area below the tide elevation was assumed to be completely blocked by the tide. No storm flow would be allowed to move downstream below this elevation.

The low chord of the bridge under this alternative would be set at the resulting water surface elevation with zero freeboard. The bridge would also be constructed with appropriate sloped abutment embankments and stone scour protection. The upstream channel elevation under the bridge would be set at EL= -0.5 foot to provide a constant channel slope to the downstream side of the proposed bridge.

The results of the evaluation for the 85-foot-long versus the 70-foot-long clear span bridge opening were summarized in the previously submitted "*Additional HEC-RAS Modeling to Set Bridge Low Chord Elevation*" dated September 30, 2008. The resultant water surface elevations for the three bridge openings were similar. Therefore, only the proposed 70-foot-long bridge opening was brought forward in this Feasibility Study.

Folder 1 on the Additional Data CD included with this report**,** contain the model results for the bridge alternatives. A schematic of the proposed 70-foot-long bridge with a new spillway and Denil fishway is included in **Figure 8**.

2.3.2 Proposed Spillway

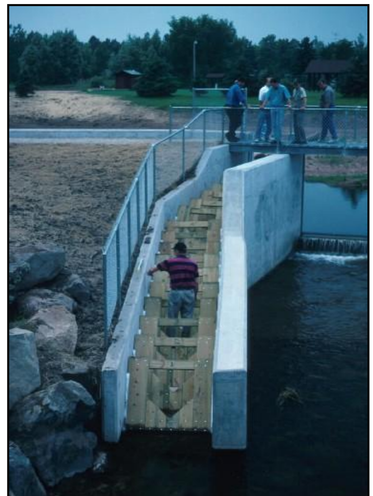
The new bridge and spillway location was selected as it is the approximate historic location of the 25-foot-wide river channel, prior to the construction of I-95, according to the 1948 construction plans. The more southerly location of the new bridge was also chosen to allow NHDOT to construct the bridge in the dry, thus avoiding the difficulties of maintaining the river flow if the existing bridge was replaced at its present location.

In accordance with NHDES Dam Safety Bureau Administrative Rule Env-Wr 101.09, the new spillway would be considered "High Hazard" as its failure would cause "structural damage to an interstate highway which could render the roadway impassable or otherwise interrupt public safety services". Since

this is an existing dam, the design strom is 2.5 times the 100-years storm event. The Probable Maximum Flood (PMF) discharge requirement applies only to new construction of High Hazard dams.
Due to soft underlying soils, the proposed Taylor River Pond spillway would probably be supported on piles that penetrate the "muck" and clay, and bear in sand or till underlying the clay (at EL -45 to -75, or possibly deeper). (See Section 3.2 for more details regarding soils in the project vicinity.) A seepage cutoff wall may be required to be provided along the upstream edges (3 sides) of the structure. The cutoff wall should consist of steel sheet piles driven into the clay soils (EL 0 to -25) or driven through the clay into the underlying sand or till and should be tied into the existing highway embankment. If the sheet piles are driven into the denser soils, then they could serve as both the support piles and the seepage cutoff.

Steel will corrode in a marine environment. This concern needs to be addressed during final design by a combination of embedment in concrete, sacrificial thickness of steel, embedment in soil, and possibly a coating. The details would depend on a number of factors, including the type and layout of the final structure.

The proposed spillway was analyzed at the existing primary spillway elevation of 8.55 feet National Geodetic Vertical Datum of 1929 (NGVD29).



Denil Fishway at Trout Creek Dam, Trout Creek, Ontonagon County, MI

2.3.3 Proposed Fishway

Three fishway options were evaluated for the proposed spillway, as follows:

- Alternative B1: Denil fishway.
- Alternative B2: Alaskan Steep Pass Fishway[5].
- Alternative B3: Rock Ramp Fishway.

The final design of the selected fishway would need to be coordinated and pre-approved by the NHFGD and USFWS. A description for each of these fishway options is provided below.

2.3.3.1 Alternative B1: Denil Fishway

Under this alternative, a new 4-foot-wide Denil fishway with a 30-inch wide downstream entrance would be constructed on the north side of the proposed spillway Dam. Denil fishways are known to be effective fish passage devices for stronger-swimming species such as river herring, American shad, Atlantic salmon, and some riverine species such as suckers. Weaker swimming species such as rainbow smelt or American eel elvers, however, may not be able to traverse a Denil fishway. Eel ramps or eelways have been constructed for the upstream passage of elvers on some New England coastal streams. The inclusion of an eel ramp in the project will be reviewed durign the Final Design stage of the project. The new Taylor River fishway would have a slope of 1:6, a single turning or resting pool, with 30-inches between baffles. Normal water depth within the fishway would be 2 to 4 feet.

The Denil fishway is self-regulating over a range of approximately 2 feet in headwater level. "Stoplogs" would be installed at the upstream and downstream ends of the fishway to allow closure during times of

[5]The Alaskan Steep Pass fishway is a modular prefabricated Denil fishway variant originally designed for remote areas of Alaska.

non-use. The fishway would be constructed as an integral part of the proposed spillway structure and tied to the adjacent I-95 sideslopes of the earthen embankment.

Based on input from Project Partners on fishway options, this is the preferred option for Alternative B. A schematic of this proposed layout is shown in **Figure 8**.

2.3.3.2 Alternative B2: Alaskan Steep Pass Fishway

This is a prefabricated (usually stainless steel) variant of a Denil fishway, originally designed for transport to remote sites in Alaska for salmon passage over natural obstructions. Although the Steep Pass is effective for river herring passage, it has a more limited operating range and may be more susceptible to internal debris problems than the standard Denil fishway. The Steep Pass may also be more subject to damage by river debris during high flow events, because of its lighter-weight steel construction. Because of these potential issues and the NHFGD preference for a standard Denil fishway, this alternative was not evaluated in more detail.

2.3.3.3 Alternative B3: Rock Ramp Fishway

A rock ramp fishway consists of a cobble/boulder ramp typically constructed at the downstream face of the spillway so that water levels in an impoundment are maintained, while providing a more natural-type passage route for migratory fish above the Dam. A rock ramp can be constructed so that a range of species can be accommodated, including weaker swimming species such as American eel elvers. A rock ramp usually consists of a series of small, irregular “step-pools”, at an approximate slope of 20:1, so that fish are able to work their way over the spillway much the same as in a natural riffle area.

For this alternative, the rock ramp would be installed across the full width of the new river channel under the proposed bridge. The upstream end of the rock ramp would be the spillway (and thus would maintain the impoundment), and would be tied into the I-95 sideslope/earthen embankment. For a 13-foot drop in elevation from the pond to the invert downstream of the new bridge, this would require a rock ramp of about 260 feet in length, which would extend beneath the proposed I-95 bridge.

Because of the potential size and cost of this structure, as well as the limited use and experience with the rock ramp design in the Northeastern United States, the rock ramp was not considered a viable fish passage alternative by the NHFGD and USFWS. Therefore, this alternative was not evaluated in more detail.

2.4 Alternative C: I-95 Bridge Replacement without Spillway

Alternative C consists of the removal of the existing I-95 bridge, and the primary spillway/fishway, and emergency spillway/culvert, and the construction of a new concrete bridge located near the historic river channel. This alternative is similar to Alternative B, except it does not include the construction of a new spillway. It does not require a new fishway. Details on the bridge replacement are discussed in Section 2.3.1 above.

3.0 ENVIRONMENTAL ASSESSMENT OF ALTERNATIVES

3.1 Hydraulic Analysis

Hydraulic analyses of the Taylor River and I-95 bridge were conducted using the HydroCAD® and USACE HEC-RAS hydraulic modeling software. The software was used to predict water surface elevations and velocity profiles for the existing and new alternatives. The two models and their respective input and output data for the above alternatives are described below.

3.1.1 HydroCAD® Model Development

The HydroCAD® model software is a hydrograph routing model. It is designed to determine time varying runoff flows, in the form of a hydrograph, as required for the sizing or evaluation of an impoundment outlet structure. For this project, the software's US Department of Agriculture (USDA) Soil Conservation Services (SCS) "SCS TR-20" method for a Type III 24-hour duration storm was used to evaluate the existing primary spillway and emergency spillway/culvert, and the proposed spillway under Alternative B, as stated in Section 2.1 above.

The following data were used to evaluate the surface runoff and hydraulic routing through the Taylor River watershed and the Taylor River Pond Dam:

- Watershed and dam HydroCAD® model data and manual calculations prepared by the NHDES Dam Safety Bureau, dated November and December 2004 (and verified by Berger).
- Fall 2006 NHDOT field survey data for the Rice Dam, Towle Farm Road crossing, and the I-95 Taylor River Pond primary spillway and fishway, bridge, and emergency spillway/culvert.
- Fall 2006 Col-East aerial survey data for the Taylor River Pond and surrounding area.
- 2006 HydroTerra bathymetric survey data for the bottom of the Taylor River Pond.

Towle Farm Road Bridge

The HydroCAD® model input data included weighted Curve Numbers (CNs) based on soil types and ground covers, and times of concentration (T_c) for each sub-catchment based on groundcover and hydraulic type (sheet flow, shallow concentrated flow, etc.), as verified by Berger.

Dimensions and elevations of the three existing upstream dams were taken from the NHDES evaluation to develop the stage-storage rating curves for the storage volumes behind these dam structures. The Col-East, Inc. aerial survey combined with the impoundment bathymetry survey data, and the NHDOT survey data were used to analyze the following existing and proposed Taylor River Pond spillway conditions:

- Alternative A: Existing Conditions with the 15.2-foot-wide primary spillway (EL 8.55 feet) and the existing I-95 bridge over Taylor River; and the 39.7-foot-wide emergency spillway (EL 9.03 feet) with the existing 5.7-foot high by 8.0-foot-wide by 260-foot-long pipe arch culvert in-place (**Figure 9**).

- Alternative B: Proposed Conditions with a proposed 50-foot-wide spillway at the existing elevation (EL 8.55 feet) (**Figures 10** and **11**). This alternative also includes a new 70-foot-long bridge and a new fishway; however, only the proposed spillway conditions were analyzed using the HydroCAD® model.

Alternative C was not analyzed using the HydroCAD® model as it did not include the evaluation of a spillway. Alternative C was evaluated using the HEC-RAS model, as described in Section 3.1.2, below.

The proposed spillway under Alternative B would be constructed near the historical river channel location, as shown on the above referenced figures, just upstream of the proposed I-95 bridge. All spillway alternatives were evaluated for 2-, 10-, 50-, and 100-year storm events, with rainfall depths of 3.1 inches, 4.4 inches, 5.75 inches, and 6.60 inches, respectively.

Table 1 summarizes the results of the HydroCAD® model analysis for the spillway alternatives. The model output reports are presented in **Folder 1** on the Additional Data CD included with this report.

3.1.2 HEC-RAS Model Development

HEC-RAS is designed to perform one-dimensional hydraulic calculations for a full network of natural and constructed channels. The model is intended to calculate water surface elevations for steady, gradually varied flow. The steady flow component of the model is capable of modeling subcritical, supercritical and mixed flow regime water surface profiles. The program utilizes the one-dimensional energy equation. Energy losses are evaluated by friction (Manning's Equation) and contraction/expansion (coefficient multiplied by the change in velocity head). The momentum equation is utilized in situations where the water surface profile is rapidly varied. These conditions include mixed flow regime (*i.e.*, hydraulic jumps), hydraulics of the bridge and evaluating profiles at river confluences.

The prepared Base Plan and supporting data were used to develop a river alignment and hydraulic cross-sections through the reach, starting from the downstream face of Old Stage Road (Station 70+90) to downstream of I-95, within the tidal estuary (Station 1+99).

The hydraulic model river alignment and cross-sections are presented in **Figures 3** through **6**.

The hydrology results from the above HydroCAD® model analysis and HEC-RAS was used to analyze Alternatives B and C for the 2-, 10-, 50-, and 100-year storm events, with the High Monthly Tide (EL 7.21 feet) blocked[7]. A 70-foot-long clear span bridge with a 25-foot-wide channel with a 50-foot-wide spillway set at EL= 8.55 feet and a new fishway were used in this analysis. As stated above, the new structures would be installed close to the location of the former Taylor River historic channel at I-95, just south of the town line (**Figures 10** to **12**).

Tables 2 to **4** summarize analysis results and water surface elevations as modeled, adjacent to the Chamberlain residence and at the upstream side of the proposed I-95 bridge for the proposed 70-foot-long bridge with and without the new spillway (Alternatives B and C, respectively). The model output reports are provided in **Folder 1** on the Additional Data CD included with this report.

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[7] The models were run with the channel flow area "blocked" below the elevation of the High Monthly Tide surge elevation, in combination with the freshwater storm event.

3.1.3 Abutter Flood Conditions

The critical storm to review is the High Monthly Tide with the 100-year freshwater storm at the Chamberlain property, adjacent to Taylor River Pond (river Station 4+48). Based on the HEC-RAS model results (see **Tables 2** to **4**), removing the existing Taylor River Pond primary spillway and emergency spillway/culvert, and installing a new bridge, will substantially lower the flood elevation adjacent to the Chamberlain residence. Also, as shown in **Tables 3** and **4**, the water surface elevation just upstream of the proposed bridge (river Station 6+97) is essentially the same for both Alternatives A and B (approximately 12.7 feet). This indicates that the spillway does not influence the water surface elevation under the proposed bridge.

3.2 Geology

Berger's subconsultant GEI obtained and reviewed the necessary available geologic information relative to the bridge replacement options and spillway removal/replacement options for the I-95 bridge and Taylor River Pond Dam. The following sections have been incorporated from information provided by GEI, entitled "Input to Feasibility Study", dated October 23, 2007 (**Appendix C**).

GEI reviewed published information on bedrock and surficial geology from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) soil survey information; and information available from the Geographically Referenced Analysis and Information Transfer, or "GRANIT[8]" website (**Table 1** in **Appendix C**).

3.2.1 Bedrock Geology

Novotny (1969) identified the bedrock in the project area as part of the Kittery Formation, possibly containing slate, phyllite, schist, quartzite, or lime-silicate rock (**Figures 1** and **2** in **Appendix C)**. **Table 1** in **Appendix C** contains an excerpt from the text of the reference that describes the conditions.

3.2.2 Surficial Geology

The surficial geology maps of the Exeter and Hampton quadrangles (Goldsmith, 2001; Koteff, et al., 1989) show interpretations of surficial geology for the western and eastern portions, respectively, of the project area. The interpretations have been incorporated into the mapping available on the GRANIT website to provide a combined picture (**Figure 3** in **Appendix C**). The surficial soils within the Taylor River's historic course and the level areas to either side are identified as salt marsh deposits – partly decomposed organic material mixed or interbedded with estuarine silt, clay, and sand. Soils just upslope from these areas to either side of the river are glaciomarine silt and clay. In the higher elevations, the soils are glacial till.

Goldthwait (1953) described the extent of marine clays in the New Hampshire Seacoast area. He indicated that the clay deposits in the project area follow the course of the Taylor River and underlie the estuarine (salt marsh) deposits and portions of the adjacent glaciomarine (glacially deposited sand, silt, and clay) deposits. He described potential commercial uses of the clay but did not provide geotechnical information.

[8] The GRANIT website is New Hampshire's statewide geographic information system and contains information on a number of topics, including transportation, geology, land use, and conservation and wetland areas. The website address is: http://www.granit.sr.unh.edu/. The search engine within GRANIT can be accessed directly at: http://www.granit.sr.unh.edu/cgi-bin/load_file?PATH=/data/database/index.html.

3.2.3 Soils

The Rockingham County Soil Survey (U.S. Soil Conservation Service, 1994) provides very detailed information on the soil within 5 feet of the ground surface. It contains aerial photographs with the various map units (areas within which soils are similar) delineated, and the text of the reference contains descriptions of the soils in each unit. These delineations were incorporated into the mapping available on the GRANIT website (**Figure 1** in **Appendix C**). The soil survey information describes the surficial soils along the Taylor River's historic course as "Ipswich mucky peat." The rest of the project area is divided into a number of different map units, but the soils in most of those units are generally described as "sandy loam". **Appendix C** includes more detailed soil descriptions.

3.2.4 NHDOT Geotechnical Information

The following NHDOT bridge drawings and geotechnical information of the project area were also reviewed:

- 1948 drawings for the Taylor River I-95 Bridge (under what is now the southbound I-95 embankment).
- 1953 drawing showing modifications to the Taylor River Pond Dam.
- 1971-72 drawings for the extension of the Taylor River I-95 Bridge under the then proposed (now existing) northbound embankment.
- 1971-72 drawings for a contract (Project P-1235-B, Contract 2) for construction of the current northbound embankment from Route 107 to Towle Farm Road.
- 1971-72 drawings (revised 1975) for the Taylor River Relief Structure (corrugated metal culvert and sheet pile emergency spillway).

Note that an elevation datum is not given on any of the reviewed drawings. It is assumed that the datum was NGVD29, which is about 0.8 foot below the North American Vertical Datum of 1988 (NAVD 1988) in this area. The following information is provided from the above list of drawings:

- <u>1948 drawings for the Taylor River I-95 Bridge</u>: These drawings included a boring location plan and logs of 21 borings that were drilled to the west of the highway embankment, presumably to identify a location for the bridge. **Appendix C** contains copies of the boring plan, logs, and legend. The information from the borings is summarized as follows:

    - <u>Historic Taylor River Channel:</u> Fifteen of the borings (Borings 1 through 19; no data were available for Borings 4, 6, 9, and 11) were performed in a nearly level area at approximate EL 4 adjacent to the historic Taylor River channel. These borings encountered deposits of very soft organic soils, described as soft peat, peaty silt, silt, and clay, extending to depths of up to 22 feet (EL -18). These soils were underlain by a layer of clay that extended to depths of up to 57 feet (EL -53). The clay was generally very soft to soft, but in places, the upper part of the clay (as much as 10 feet) was stiff to very stiff. In some of the borings, the upper part of the clay layer was found to contain layers of sand or silty sand, with occasional mention of shells or gravel in the logs. The clay was underlain by loose to medium dense fine sand and clay, with some zones containing gravel. This layer ranged from 4 to 20 feet in thickness. Refusal, interpreted on most of the logs as bedrock ("ledge") or a boulder, was encountered just below the sand layer, at depths of about 50 to 70 feet in these borings.

- Lower River Bank: One of the other borings, No. 26, appears to have been drilled up on the river bank, at EL 9, and encountered no soft organic soils at the surface, but instead encountered 14 feet of silty sand with little clay. Below this sand, the boring encountered conditions similar to those in the borings described above: 20 feet of soft clay, underlain by 15 feet of loose to medium dense sand and clay. The top of this sand/clay layer was at EL -25. The boring was stopped, possibly upon refusal, at a depth of 49 feet (EL -40).
- Upper River Bank: The remaining 5 borings (Borings 21, 22, 23, 24, and 25) were drilled higher on the bank to the north of the Taylor River channel. The ground surface was at about EL 13 for these borings. These borings encountered no soft organic deposits. The surficial soils were medium dense to dense sand and silt with little clay, extending to depths of 12 to 15 feet. In three of these borings, the surficial sand was underlain by 2 to 13 feet of soft to medium stiff clay, which was underlain in turn by dense to very dense sand and gravel. In the other two borings, the surficial sand was underlain directly by the dense to very dense sand and gravel. This dense granular soil appears to be different than the sand found beneath the clay in the other borings. The top of the dense granular soil ranged from EL -15 to +1. The borings were stopped at elevations ranging from -22 to -8, though refusal was noted for only one of the borings.

The drawings indicate that the bridge consists of a concrete slab supported by sheet piles driven to elevations varying from -8 to -12, into the dense sand underneath the clay. It appears that the bridge location was selected so that it could be easily founded in the dense sand. The river channel is indicated to be at EL 0, and the underside of the top slab is at EL 8. The bridge span is 15 feet.

- 1953 drawing showing modifications to the Taylor River Pond Dam: The drawing does not include geotechnical information but indicates that the sheet piles making up the primary spillway were to have been driven to elevations varying from -13 to -22. Based on the boring logs described above, these sheet piles would have been driven into the dense sand and gravel underlying the clay. The primary spillway of the Dam is indicated to be at EL 8±, and the non-overflow portions are shown at EL 11. The plan of the Dam appears to be similar to the existing condition. The drawing shows stone fill against the downstream face of the primary spillway, though no stone is now visible in this area. The drawing shows no stoplogs or fishway, as currently exists.

- 1971-72 drawings for the extension of the Taylor River Bridge: One of the drawings includes a boring location plan and logs of three borings. The borings found dense to very dense granular soils and cobbles from the ground surface to refusal at EL -33 to -22. A copy of this drawing is included in **Appendix C**.

  The bridge extension followed the same design as the original bridge, except that all of the sheet piles are shown to be driven to EL -12. The drawings show the Taylor River Pond primary spillway at EL 7.8. They also show proposed rehabilitation of the existing sheet piles, by means of 3/8-inch steel plates attached to the portions of the sheet piles between EL 2.75 and 7.25.

- 1971-72 drawings for a contract (Project P-1235-B, Contract 2) for construction of the current northbound embankment from Route 107 to Towle Farm Road: These drawings do not include a 1,065-foot length where the highway crosses the historic location of the Taylor River. That 1,065-foot portion was apparently in another contract, the drawings for which are not available. Fortunately, the available contract drawings show some information in the Taylor River area, on the highway profiles and cross-sections. The cross-sections show the then-existing ground surface and the bottom of the "muck." They indicate that the muck was to have been excavated within the footprint of the highway embankment and that a sand drainage blanket was to have been placed in the

bottom of the excavation before the embankment fill was placed. The muck excavation ranged up to about 30 feet in depth, down to approximate EL -20. No boring logs are included in the drawings.

- 1971-72 drawings (revised 1975) for the Taylor River Relief Structure (corrugated metal bridge and sheet pile emergency spillway): These drawings do not contain boring logs, but they show the foundation for the inlet structure to consist of sheet piles driven to EL -25. The drawings show the emergency spillway crest at EL 9 and a concrete apron downstream of the emergency spillway at EL 6. They also show that the culvert was originally to be located to the south of its present location, in the historic channel of the Taylor River, at Sta. 195+00. The 1975 as-built information indicates that the location was shifted to Sta. 196+50 during construction, to an area where the geotechnical conditions were more favorable. Based on the 1948 boring logs, the current location, which is close to Boring No. 26, is outside of the limits of the soft organic soils and where the soft clay is not as thick. It appears that the sheet piles would have reached the sand/clay layer underlying the soft clay. These drawings also show the sand drainage blanket indicated in the above Project P-1235-B drawings.

3.3 Sediments

The construction of the Taylor River Pond Dam resulted in the deposition of fine-grained sediments within the impoundment. The Taylor River drains largely forested areas, as well as some areas with farmland and rural developments (**Figure 2**). Under the spillway removal alternatives, accumulated sediment would erode in part and be transported into the tidal estuary downstream of the spillway if not properly managed.

Taylor River downstream of the Dam

Removal of spillways typically mobilizes sediments in the associated impoundment (unless mitigation measures are put in place). Mobilized sediments are then transported into downstream water bodies. Downstream impacts could consist of siltation of habitats, physical smothering of organisms, and toxicity impacts for organisms if the sediments contain contaminants at elevated concentrations.

Historically, the watershed of the Taylor River Pond was primarily used for agricultural purposes. It appears that agricultural uses have decreased over time. There are no indications of industrial development aside from a sawmill along Rice Pond. However, Taylor River has a large downstream estuarine system that the USEPA lists on the Clean Water Act Section 303d list for PCBs, dioxin, and fecal coliform. Potential sources for fecal coliform in the estuary include the freshwater component of the Taylor River watershed. Sources for PCBs and dioxin were not investigated but are likely located around the Hampton-Seabrook Marsh and Estuary. The Taylor River watershed is not expected to be a source given its history without industrial development and given the absence of PCBs in the Taylor River Pond sediments (as discussed further below).

Existing data on the sediment characteristics in the Taylor River Pond were not located. Therefore, the sediments were investigated to determine the physical and chemical characteristics of the sediment, and to determine the volume of accumulated sediment in the impoundment since the Dam was constructed. The Rice Dam impoundment was later added to the investigation, as it was recognized that a failure of the Rice Dam could result in mobilization of sediment into the downstream Taylor River Pond and the downstream estuary, under the spillway removal alternatives.

Sediments were investigated for physical and chemical characteristics. Physical characteristics consisted of the accumulated sediment volume and grain size, which was needed to assess the potential mobility of the sediment. Chemical investigations followed the Sediment Triad Approach, as specified in "Evaluation of Sediment Quality Guidance Document" (NHDES, 2005). This approach was developed to assess risks posed to benthic organisms in the sediment using the following sequential steps: (1) sediment chemical analyses; (2) sediment toxicity bioassays in the laboratory; and (3) community assessment in the field.

3.3.1 Physical Characteristics of Sediments

3.3.1.1 Methodology

In the Taylor River Pond, the thickness of accumulated sediment was assessed on December 19, 2006, throughout the impoundment, using a shallow draft boat. The water depth was recorded with a measuring rod that had a 16 x 6-inch wooden plate attached at the end to avoid penetration of the rod into the soft upper sediments layer. The depth to refusal was probed with a graduated 1¼-inch diameter hollow polyvinyl chloride (PVC) pipe. Other probes were tested such as a hollow 1-inch PVC pipe, and a ¾-inch solid steel pipe (stem of a hand auger), but the 1¼-inch pipe was considered best to detect the refusal depth.

The position of each survey location was recorded with a differential Global Positioning System (GPS) with an accuracy of approximately $\pm$6 feet. The entire impoundment was surveyed between the Taylor River Pond Dam at I-95 to approximately 600 feet downstream of the Rice Dam. Most of the impoundment was accessible with the exception of some areas that were covered with a thin sheet of ice. The areas covered with ice included the embayment at the mouth of Grapevine Run. Thickness measurements were collected along various transects in the impoundment, unless shallow water depths or ice coverage prevented access to parts of the impoundment.

The sediment depths in the Rice Dam impoundment were tested on April 6, 2007, using the same approach as for the Taylor River Pond, with the exception of using an aerial photograph for approximate positioning rather than a GPS system.

3.3.1.2 Results – Physical Characteristics

3.3.1.2.1 Taylor River Pond

At many survey locations in the Taylor River Pond, the depth to refusal was well defined. Generally, good refusal was observed in the impoundment, upstream of the Grapevine Run embayment. In the section between the Grapevine Run embayment and I-95, the refusal depth was not as well defined. However, based on observations made during the sediment sampling using a core tube and box corer, Berger feels reasonably comfortable with the recorded observations in this section as well. Specifically, it appears that the uppermost soft sediment layer in this section is underlain by former tidal marsh soil. This type of soil appears to have high root content and is, therefore, softer than the upland soil further upstream in the impoundment. Only the sediment that accumulated since the construction of the Dam was probed, *i.e.*, measurements do not include the deteriorated peat from the filled marsh.

Generally, the thickness of sediment that has accumulated in the Taylor River Pond since the Dam was constructed ranges between <0.5 and 2 feet (**Table 5**; **Figures 13, 13A** and **14** to**16**), with a mean of 1.0 foot, and a median of 0.8 foot. Differences were observed in different sections of the impoundment as follows:

• Narrow upstream portion of impoundment (500 feet south of Old Stage Road bridge to cattail wetland)	0.5 foot
• Upper impoundment (cattail wetland to Towle Farm Road)	1-2 feet
• Mid section of impoundment (Towle Farm Road to Grapevine Run Estuary):	
Channel	<0.5 foot
Shallow sections	0.5 to 1 foot
• Grapevine Run Estuary	n/a *(pond was frozen)*
• Taylor River Estate estuary	0.5 to 1 foot
• Lowermost impoundment, close to I-95	1 to 2 feet

Conceivably, the thickness of accumulated sediment is lower closer to the edges of the impoundment, although a distinct pattern was not observed. Given the comparatively steep topography of the land surrounding the Taylor River Pond, the layer of accumulated sediment may not gradually decrease in thickness toward the edges of the impoundment. Therefore, the full average sediment thickness was used for specific sections of the river for the determination of the total volume of accumulated sediment in the impoundment. Using a mean of 1-foot of accumulated sediment and 47.5 acres for the area of the impoundment, the total estimated volume of accumulated sediment is 77,000 cubic yards.

The sediment distribution throughout the Taylor River Pond appears to be fairly uniform, consisting predominantly of medium sand to clay (**Table 6**). Grain size distributions (Stations TR-S1 to 10) are provided in **Folder 2** on the Additional Data CD included with this report).

3.3.1.2.2 Rice Dam Impoundment

The Rice Dam impoundment is approximately 1,600 feet long (see **Figure 17**). The lower 1,000 feet were surveyed. The impoundment is narrow; much of the surveyed section was only approximately 60 feet wide. The upper section of the surveyed stretch does not contain much accumulated sediment. The substrate is firm without fine-grained sediment. Sediment has accumulated in the lower half of the impoundment but only to an approximate thickness of 0.3 to 0.6 foot. Near the Rice Dam, there was a layer of woody debris that prevented effective penetration into the sediment with a box corer. Nevertheless, using a rod, the sediment thickness seemed to be low as well. The water depth approximately 50 feet upstream from the dam was approximately 8 feet. This elevation was similar to the elevation of the dam, also suggesting that the sediment buildup behind the dam appears to be small. The reason for the apparent lack of sediment is likely the narrow width of the impoundment, resulting in flushing during rainstorm events with high runoff. Peak flow velocities in the Rice Dam impoundment are considerably higher than in the much wider Taylor River Pond.

Aside from the Taylor River, two small unnamed brooks enter the Rice Dam impoundment from the east (**Figure 2**). These brooks may be intermittent streams. The mouth of the smaller brook is located in the upper 1/3 of the surveyed part of the impoundment; it had a discharge rate of approximately 0.5 cubic feet per second (cfs) on April 6, 2007. The second brook enters the impoundment in the mid-section of the impoundment. It had a discharge rate of approximately 1 to 1.5 cfs. The brooks largely drain the adjacent farm and its land to the east. Small sedimentary deltas have formed at their confluence with the Rice Dam impoundment.

In the Rice Dam impoundment, sediment only accumulated in the vicinity of the dam. As in the Taylor River Pond, sediments were fine-grained (medium sand to clay). The grain size distribution for Station TR-S11 is shown in **Folder 2** on the Additional Data CD included with this report).

3.3.2 Chemical Characteristics of Sediments

3.3.2.1 Methodology

3.3.2.1.1 Sediment Chemistry

Sediments that had accumulated since the Dam was built were sampled for chemical analyses, following the Sediment Triad Approach (NHDES, 2005). The first sampling event occurred on November 30, 2006, for sediment chemical analyses. All sampling locations are shown on **Figure 13.**

A total of four sediment samples were collected (**Table 7**). Two samples were collected from within the Taylor River Pond. A third sample was collected just upstream of the pond. In addition, a fourth sample was collected downstream of the Taylor River Pond. All samples consisted of 2 to 3 subsamples that were composited by the laboratory before analysis.

The station locations are listed below (upstream to downstream). The water depths and accumulated sediment depths at each sampling location are presented in **Table 7.**

- ***TR-S1** (Upstream of Taylor River Pond):* The station was located approximately 50 feet downstream of Rice Dam (**Figure 17**). Taylor River is typically free-flowing in this section. On November 30, 2006, the impoundment extended up to the closed Old Stage Road bridge. Subsamples were collected from each of the three islands within the river channel (**Figures 18** and **19**). Samples were collected from the upper 20 centimeters (cm) of the sediment column using a stainless steel spoon.

Taylor River, downstream of Rice Dam

- ***TR-S2** (Mid Section of the Taylor River Pond):* The station was located downstream of the Towle Farm Road bridge (**Figure 20**). Samples were collected from three locations in the central portion of the impoundment and composited in the laboratory. The sampling locations were not within the deeper channel of this section of the impoundment because the thickness of accumulated sediment in the channel was very small. At all three locations, the sediment was collected with a box corer. The sediment was soft, dark, and fine-grained with some roots (**Figure 21**).

- ***TR-S5** (Lower Taylor River Pond):* The station was located close to the earthen embankment (**Figure 22**). Part of the reason for sampling this location was to capture potential contamination from stormwater runoff from I-95. Samples were collected from two locations using a box corer and were composited in the laboratory. The deeper sediments were investigated using a 2.5-inch diameter core tube with core catcher. A third station was cored, but a sample was not collected. As at Station TR-S2, the uppermost sediments were soft, dark, and fine-grained with some roots (**Figure 23**). The sediment was underlain by denser sediment with a high concentration of roots (**Figure 24**); this vegetation appeared to be tidal marsh vegetation that existed prior to the construction of the impoundment. Only the soft uppermost sediments were submitted to the laboratory for analysis.

- ***TR-S4*** *(Downstream of Taylor River Dam):* The station was located approximately 50 to 200 yards to the east of Route I-95 (**Figure 25**). Subsamples were collected at three locations and composited in the laboratory. These three locations were considered as they are expected to reflect I-95 runoff effects (if any) and general background concentrations in the impoundment. The subsamples were collected approximately 1 hour after low tide. The water elevation in the estuary at the time of sampling was approximately at -2.7 feet NGVD29. Subsample 1 of 3 was collected with a core tube between 4 and 10 inches below the water surface. Subsamples 2 of 3, and 3 of 3, were collected approximately 1 to 2 inches above the water surface using a clean stainless steel spoon (**Figures 26** and **27**).

Sediment samples were stored in a cooler with ice. The cooler was collected by the laboratory at the end of the day. The NHDES approved list of parameters and analytical methods used are listed in **Table 5**. A duplicate sample was not collected due to the low number of samples and the homogeneity of the sediment supply. Specifically, the Taylor River to the north supplies most of the sediment that enters the impoundment.

3.3.2.1.2 Sediment Toxicity Bioassays

As a result of the elevated pesticide concentrations detected in the sediments, further samples were collected on April 6, 2007. Samples were analyzed for toxicity, as the second step under the Sediment Triad Approach (NHDES, 2005). Additional grain size samples were also collected at that time. Each sample consisted of two or three subsamples that were composited later in the laboratory. A total of 0.15 cubic feet of sediment were collected at each sampling location using a box corer. The water depths and depths of refusal are listed in **Table 5**. The following samples were collected (upstream to downstream):

- ***TR-S11*** *(Rice Dam Impoundment):* The sample consisted of three subsamples (**Figure 28**). Subsample 1 was collected from the central part of the impoundment, adjacent to the white house on its western shore. Subsamples 2 and 3 were close to each other and were collected from the lower part of the impoundment, approximately 150 feet upstream of the Rice Dam.

- ***TR-S8*** *(Upper Taylor River Pond):* The station was located approximately 200 feet upstream of the Towle Farm Road Bridge (**Figure 17**). Two subsamples were collected, approximately 30 feet apart.

- ***TR-S7*** *(Mid section of Taylor River Pond; vicinity of TR-S2):* As for sample TR-S2, three subsamples were collected (**Figure 20**).

- ***TR-S9*** *(Downstream of Sample TR-S7):* The station was located approximately 1/3 of the way between Stations TR-S7 and TR-S6 (**Figure 20**). Two subsamples were collected, approximately 30 feet apart. The sample was only analyzed for grain size.

- ***TR-S10*** *(Downstream of Sample TR-S9):* The station was located approximately 2/3 of the way between Station TR-S7 and TR-S6 (**Figure 20**). Two subsamples were collected, approximately 30 feet apart. Only grain size was analyzed.

- ***TR-S6*** *(Lower Taylor River Pond; vicinity of sample TR-S5):* This sample consisted of three subsamples, rather than two subsamples collected for TR-S5 (**Figure 22**).

The toxicity bioassay analyses were conducted by the Envirosystems laboratory in April 2007.

3.3.2.2 Results - Chemical Characteristics

Sediments in Taylor River Pond are organic-rich with total organic carbon (TOC) concentrations ranging between 4 and 8% (**Tables 8** to **10**; **Folder 2** on the Additional Data CD). Sediments in both the Rice Dam impoundment and Taylor River Pond contain pesticides, metals, and polycyclic aromatic hydrocarbons (PAHs) at concentrations that exceed sediment guideline values for both freshwater and marine waters. Pesticides of particular concern are dichlorodiphenyldichloroethane (DDD), dichlorodiphenyldichloro-ethylene (DDE), and dichlorodiphenyltrichloroethane (DDT). Semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), and PCBs were not detected, or were detected at concentrations that did not exceed sediment guideline values.

Sediments in the Rice Dam impoundment are organic-rich, with TOC concentrations of 5%. The Rice Dam impoundment also had elevated concentrations of pesticides and PAHs exceeding sediment quality guidelines; although the concentrations were overall lower than in the Taylor River Pond. Lower concentrations could be due to more frequent flushing of the Rice Dam impoundment (due to its narrower width), which would result in sediments of generally more recent age.

The toxicity tests of the freshwater amphipod *Hyalella azteca* showed comparatively high survival and growth in both impoundments, as compared to laboratory control samples (see **Folder 3** on the Additional Data CD included with this report). *Hyalella* is considered epibenthic,[9] burrowing typically to a depth of only about 1 millimeter, according to Mr. Ken Simon from the Envirosystems laboratory. Mr. Simon also stated that *Hyalella* is more sensitive to metals and PAHs, and not as sensitive to pesticides.

The toxicity tests of the freshwater midge *Chironomus dilutus* showed significantly reduced survival in the lower section of the Taylor River Pond near the primary spillway (Station TR-S6), and at Station TR-S11 (Rice Dam impoundment), as compared to the laboratory control sample (see **Folder 3** on the Additional Data CD included with this report). Sample TR-S7 (mid section of the Taylor River Pond) did not have significantly reduced survival rates. Growth was only significantly reduced at Station TR-S6, as compared to the laboratory control sample. *Chironomus* burrows more than 1 or 2 inches into the sediment. The organism is also particularly sensitive to pesticides, among a few other compounds, according to Ken Simon from Envirosystems.

For the Lower Taylor River Pond (at Station TR-S6), the *Chironomus* data (*i.e.*, statistical difference of 20% for survival and 25% for growth, compared to the control sample), warranted further action as specified by the Guidance Document (NHDES, 2005). For the upper Taylor River Pond and the Rice Dam impoundment, the differences were not sufficient to warrant further action.

3.3.3 Fish Tissue Analyses

Fish sampling in the Taylor River Pond was conducted in response to the chemical analyses and toxicity bioassays of the sediments. The objective of the investigation was to assess potential impacts to human health and the aquatic ecosystem.

[9] Epibenthic: Living above the bottom.

3.3.3.1 Field Sampling (Prepared by Cheri Patterson, NHFGD)

Bluegill Sunfish (*Example*)

The NHFGD collected fish between April 25, 2007, and June 25, 2007, for the NHDOT's assessment of the public and wildlife risk associated with contaminants found in the sediment of the Taylor River Pond. An electrofish boat and gill net were utilized to collect fish from the littoral[10]/pelagic[11] and benthic zones, respectively, of the pond. Twelve fish collected from both the littoral/pelagic and benthic zones were filleted for lab analysis to assess the public health risk relating to the known contaminants. In addition, 23 whole fish were collected from the littoral/pelagic zone to assess the associated wildlife risk. All fish collected for lab analysis were equal to or less than 12 inches in length[12]. Each fish retained for analysis was measured, weighed, either filleted or maintained whole and placed in a labeled plastic bag (**Table 11**). These samples were kept in a cooler during field sampling until delivered to the NHDES where they were kept in a freezer until all samples had been collected. Once both littoral/pelagic and benthic samples were collected, they were transferred to the laboratory conducting the analysis (Severn Trent Laboratory [STL], located in Burlington, Vermont) on July 3, 2007.

- On April 25, 2007, electrofish sampling commenced at approximately 10:30 am along the Taylor River Pond's northeast and southern shorelines (**Figure 29**). The species observed during the 2.5-hour sampling period were: American eel (abundant), Eastern chain pickerel, largemouth bass, golden shiner, sunfish (bluegill and redbreasted), and black crappie. The species collected for the risk assessment were Eastern chain pickerel and largemouth bass from the littoral/pelagic zone of the impoundment. The species absent from this sampling were from the benthic zone leading to different methods of collection.

- On May 2, 2007, a fyke net was set approximately 100 feet downstream of Old Stage Road to capture any spring spawning benthic species (*e.g.*, common sucker) that may be utilizing riverine habitat. The 24-hour set produced no fish; however, a hole was found within the net, indicating wildlife had penetrated the net. The net was not reset.

- From May 10 through June 25, 2007, a 100-foot variable mesh (1 3/4", 2", and 2 1/2") gill net was set primarily along the southwestern shore of the Taylor River Pond for benthic fish sampling. The net was checked daily (weather permitting) for benthic fish species. The daily sets were repositioned at various locations within the area indicated in **Figure 29**. The fish encountered in the net were identified and either released alive, or if dead, measured and then discarded. Those processed in the field were only measured while those processed in the office were measured and weighed. Those fish species that were immeasurable due to consumption by snapping turtles were identified and discarded. The only benthic fish species encountered were brown bullhead. The fish filets were processed for lab analysis as noted above and kept at the Region 3 freezer (Marine Fisheries Division) until all twelve samples were collected. The samples were relayed to NHDES for final delivery of all samples to the contracted lab. See **Table 11** for fish species encountered during this sampling period.

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[10] Littoral: Littoral is that portion of the lake that is generally less than 15 feet in depth. This is the zone with most of the aquatic plant life (both rooted and floating) in a pond because the high amount of sunlight reaching it allows for significant photosynthetic activity.

[11] Pelagic: The pelagic zone is the descriptive term for the ecological region above the benthos, including the water-column up to the surface.

[12] 12-inch is a standardized length that would be most commonly consumed by either humans or wildlife.

3.3.3.2 Laboratory Analyses

Samples were analyzed for pesticides using EPA Method 8081A. The laboratory provided three data reports, as samples were analyzed in batches of up to 20 samples (**Folder 3** on the Additional Data CD). All laboratory data are summarized in **Table 12**; blank spaces in the table reflect that the compound was not detected at the reporting limit.

The laboratory (STL) completed and provided all the necessary quality control data, which were adequate and complete (reports are included in **Folder 3** on the Additional Data CD). The Case Narratives for the three individual reports (two dated July 27, 2007, and one dated July 31, 2007) described issues encountered with the analyses and their effect on data quality.

- STL utilized a "P" notation in the Analysis Data Sheets (Form 1) which according to the Data Qualifier and Definitions page, has two definitions: (1) "SW-846: Greater than 40% difference for detected concentrations between two GC columns. Unless otherwise specified, the higher of the two values is reported on the Form 1" and (2) CLP SOW: Greater than 25% difference for detected concentrations between two GC columns. Unless otherwise specified, the lower of the two values is reported on the Form 1." The lab utilized the first definition and reported the higher values. There were a total of 39 values with a "P" notation provided on Form 1. Some of the %Differences between the two column runs were high. For example, (1) sample TRF-40: beta-BHC, the reported result was 2.7 micrograms per kilograms (ųg/kg), the confirmatory column result was 0.54 ųg/kg and the %Difference was 400%; and, (2) sample TRF-39: 2,4' dichlorodiphenyldichloroethylene (DDE), the reported result was 1.7 ųg/kg, the confirmatory column was 0.51 ųg/kg the %Difference was 233%. Other %Differences were in the 70-100% range. The difference in concentrations is a result of positive or negative interference during the analysis in the respective GC column. The higher concentrations were reported in the lab and data summary (**Folder 3** on the Additional Data CD; **Table 12**), and used in the data synthesis as a conservative measure.

  The only exception was Heptaclor epoxide in Sample TRF-44 where the lower value was reported (0.46 ųg/kg). According to the lab, there was a large interfering peak in the retention time window for heptachlor epoxide on the RTX-CLPII column that resulted in a high bias for this compound (11 ųg/kg). This was not present on the RTX-CLP column (*i.e.*, 0.46 ųg/kg). Therefore, in this instance, the lower value (RTX-CLP column) was chosen by the lab for reporting.

- In addition, there were compounds with "E" and "D" notations reported. The "E" notation was given to compounds whose concentrations exceeded the upper limit of the calibration range of the instrument for that specific analysis. There was only one value with an "E" notation reported for the study in sample TRF-01 - 4,4' DDE (22 ųg/kg). The "D" notation was for concentrations identified from analysis of the sample at a secondary dilution. Three compounds in sample TRF-01DL: (1) 4,4' DDD (3.4 ųg/kg), (2) 4,4' DDE (21 ųg/kg), and (3) 4,4' DDT (1.1 ųg/kg). The data analyses used the results of sample TRF-01DL, and not the values for sample TRF-01.

3.3.3.3 Results - Fish Tissue and Human Health Assessment (Prepared by Pam Schnepper, NHDES)

The ecological risk of pesticide to benthos, fish, and wildlife in the Taylor River Pond was prepared by Pam Schnepper in a memorandum from September 9, 2007. Aside from a few minor editorial changes, the text in this section was taken directly from the memorandum.

Many organochlorine pesticides have been banned for use in the United States including dichlorodiphenyltrichloroethane (DDT), aldrin, dieldrin, toxaphene, chlordane, and heptachlor. Unfortunately, most organochlorine pesticides break down slowly and can remain in the environment

long after application and in organisms long after exposure. Exposure to organochlorines can produce a wide range of acute and chronic health effects, including cancer, neurological damage, and birth defects.

Based on the sediment chemistry analysis, some sediment samples from the Taylor River contained elevated levels of DDT and its breakdown products. In humans, exposure to high levels of DDT has been associated with nervous system stimulation: excitability, tremors and seizures. Additional potential adverse health effects from DDT exposure that have been observed in animals include changes in the lungs, liver, adrenal, reproductive and immunological systems. Although DDT has not been demonstrated to cause cancer in humans, EPA considers DDT to be a probable human carcinogen because DDT and its metabolites have been associated with liver cancer in animals (ATSDR, 2002). Collection of fish from the Taylor River was warranted to determine if the sediment contamination presents a health risk to fish consumers.

NHDES would consider issuing a water-body specific fish consumption advisory if consumption of fish from the Taylor River at the rate of the statewide advisory would result in an exposure that exceeds EPA risk-based levels. The statewide advisory recommends limiting the consumption of freshwater fish due to mercury contamination. Women of childbearing age and children are advised to limit their intake to one six-ounce portion per month. Other adults may eat four portions per month. In addition, because contaminants such as DDT and mercury may bioaccumulate in fish, for fish that eat other fish such as bass and pickerel, only fish that are 12 inches or less should be eaten.

Fish sampling to assess potential organochlorine pesticide contamination was conducted according to the EPA guidance (USEPA, 2000a). Two species were collected for chemical analysis of fillet tissue. The brown bullhead is a bottom feeder, which may have greater contact with contaminated sediment. Largemouth bass represent an upper trophic level predator, which may have higher levels of bio-accumulative toxins such as organochlorines. To be consistent with the consumption limits of the statewide advisory, the length of fish collected was less than 12 inches.

Twelve fillet samples of each species were analyzed by the laboratory (STL). The results as used in the human health analysis are presented in **Table 13**. For calculation of total metabolites, non-detect values were quantified using one-half of the method detection limit. DDT (total) is the sum of DDT, DDE, and DDD congeners. Heptachlor (total) is the sum of heptachlor and heptachlor epoxide. Chlordane (total) is the sum of oxychlordane, trans-nonachlor, cis-nonachlor and gamma chlordane. Summary statistics were generated using USEPA's ProUCL program.

DDT metabolites were detected in all of the fish sampled; additional pesticides, detected at a frequency of greater than 10% in the overall fillet dataset, include dieldrin, and heptachlor and chlordane metabolites. Summary statistics for these compounds are presented in **Table 14**.

The average fillet DDT (total) concentration was 17 ųg/kg for brown bullhead and 29 ųg/kg for largemouth bass. For comparison, the U.S. Geological Survey's National Water Quality Assessment Plan has assessed DDT contamination in sediments and fish. Analysis of whole fish from 208 different water-bodies that represent mixed land uses (agricultural, undeveloped, and urban areas) detected DDT and its metabolites in 93% of the samples analyzed with a mean DDT(total) concentration of 49.8 ųg/kg (Nowell and Crawford, 2003).

New Hampshire fish consumption advisories are based on 95^{th}% upper concentration limit (UCL) fish tissue concentrations. The UCL is a statistical estimation that provides 95% confidence that any individual fish sample will not have a greater concentration. Risk-based fish consumption limits were obtained from EPA guidance (USEPA, 2000b). As **Table 14** shows, the 95^{th}% UCL chemical concentrations for all of the contaminants are below the EPA risk-based consumption limits.

Therefore, consumption of Taylor River fish at the rate recommended in the statewide fish consumption advisory is unlikely to present any appreciable risk of adverse health effects.

3.3.4 Ecological Risk Assessment (Prepared by Lori Siegel, NHDES)

The ecological risk of pesticide to benthos, fish, and wildlife in the Taylor River Pond was prepared by Lori Siegel in a memorandum from September 6, 2007. Aside from a few minor editorial changes, the text in this section was taken directly from the memorandum. References cited in her assessment consisted of the following: Poulsen and Peterson (2006); Sample, Opresko, and Suter (1996); and USEPA (1993).

After careful consideration of the sediment and fish data relevant to the Taylor River Dam site in Hampton/Hampton Falls, NH, Ms. Siegel determined that there is indeed enough ecological risk to warrant limited risk management. Her rationale for this determination was as follows:

- The sediment data has levels of DDT and derivatives that exceed the lower and upper thresholds and bulk sediment bioassays support the toxicity, particularly in the impoundment adjacent to the Dam.

- The fish data indicates the upper 95% confidence level of contaminant concentrations poses risk to birds (using Osprey adults and eggs and Great Blue Herron adults as indicators) (**Table 15**).

Although these analyses reveal an unacceptable ecological risk, the level of those risk factors into decisions regarding the mitigation of that risk. The levels in fish are protective of mammals (using mink as an indicator species) and of fish (using Lake Trout as an indicator species). Furthermore, the risk to birds (adult and egg) assumes a diet consisting of 100% fish from the area of interest. More realistically, birds are ingesting less than that, thereby proportionally reducing that risk.

3.3.5 Impact Analysis

The impact analysis incorporates the findings of the physical and chemical assessments of the studies, as well as the fish tissue and human health assessment (prepared by Pam Schnepper) and Ecological Risk Assessment (prepared by Lori Siegel).

In a memorandum from March 18, 2008, the NHDES determined the following:

> "The Department recognizes that the organochlorine pesticides were unlikely released from any of NHDOT activities but are more likely due to a release of historic agricultural or mosquito control applications. Nonetheless, the presence of the spillways has allowed the pesticides to accumulate in the pond. Accordingly, removal or reconstruction of the spillway could release this contaminated sediment, thereby compromising the integrity of the downstream aquatic environment. Such activity conducted by NHDOT, which requires a Wetlands Permit, thus requires a Water Quality Certificate from the Department's Watershed Management Program. The Water Quality Certificate is to ensure water quality standards will be met during and subsequent to spillway removal or reconstruction work conducted by NHDOT.
>
> Based on the review of the sediment and fish data, the Ecological Risk Program concluded the following in the September 6, 2007 memo: *"….there is indeed enough ecological risk to warrant risk management."* As a result, the [NHDES] will list this portion of the Taylor River as impaired for aquatic life and wildlife uses. Moreover, a list of four (4) recommended actions

was provided to NHDOT for management of this risk as indicated below. Please note the actions noted below … reflect the most updated information based on meetings subsequent to the September 6, 2007 memo:

- Skip the community assessment. With the weight of evidence given by the sediment chemistry and toxicity tests, a community assessment would not alter the determination that the sediment endangers the benthos there. Moreover, if the spillways are indeed removed, then the geochemical conditions would change so much that the community assessment would be irrelevant.

- Remove the sediment that is most contaminated, located adjacent to the spillways. The limits of excavation can either be assumed to extend to the transect on which TR-S2 lies or additional sampling could better delineate the limits of contamination for which removal is warranted.

- Install a temporary stone trap downstream of the spillways during repair or removal work so that any sediment scoured during DOT activities there would be captured. The captured sediment would then need to be removed.

- Install check dams and plant vegetation (consider designs that accomplish both)."

This determination by NHDES from March 18, 2008 was considered in the alternatives assessment for the sediments in the Taylor River Pond. In addition to the determination above, the NHDES memorandum provided specific recommendations regarding the mitigation of sediment for Alternatives B and C. These recommendations were addressed in the conceptual Sediment Management Plan for Alternatives B and C (**Appendix D**). Key recommendations of this Sediment Management Plan are incorporated below.

3.3.5.1 Alternative A

There would be no change in the accumulated sediments volume and in the sedimentation pattern in Taylor River Pond under the No Action Alternative. However, in the case of a breach or failure of the spillways, fine-grained sediment accumulated in the pond would be released into the downstream estuary. The release would adversely impact the downstream estuary by smothering organisms, as well as affecting organisms due to the pesticides within the sediment. In addition, the large volume of mobilized sediment may clog some tidal channels. It should be noted that some fine sediments may be transported currently over the Dam during storm events. There is n total containment of the sediment under current condiction.

3.3.5.2 Alternative B

Replacing the I-95 bridge and replacing the spillways with a wider one, would result in higher peak flow velocities in Taylor River Pond during high flow events. Higher flow rates would result in erosion of some of the accumulated sediment in front of the bridge.

Recommendations in the Sediment Management Plan (**Appendix D**) were designed to minimize the mobilization of impaired sediment and transport into the downstream estuary, as requested by the NHDES. In essence, the management plan recommends the removal of accumulated sediment in the impoundment from a small area in front of the proposed bridge. Based on currently available sediment and hydrological information, we recommend the removal of a trapezoidal-shaped apron with a length of 160 feet from the primary spillway, and widths of 140 feet at the edge of the existing Dam and 60 feet along the upgradient side. The removed sediment would be disposed offsite.

We recommend refining the Sediment Management Plan after a preferred alternative has been chosen and a specific construction approach has been developed. It should be noted that replacement of the Dam will not result in total containment of sediment. Similar to current conditions, some sediment transport can be anticipated during storm events.

3.3.5.3 Alternative C

This alternative entails replacement of the I-95 bridge and removal of the existing Taylor River Pond primary spillway/fishway and emergency spillway/culvert, which would lower the channel bed elevation at the location of the existing spillway to -0.5 feet. Given that the average elevation of the sediment surface in Taylor River Pond is 1.0 feet, this alternative will expose the former tidal channel in the impoundment.

The natural reestablishment of the tidal channel will mobilize sediment, unless the accumulated sediment in the channel is excavated prior to opening the current pond area to tidal flows. Erosion would result from tidal flows as high stormwater runoff events. Sediment eroded from the channel during incoming tides would result in partial deposition of sediment on the adjacent tidal marsh; the remainder of the sediment would remain in suspension and be transported downstream during the outgoing tide. Sediment eroded from the channel during the outgoing tides would be transported downstream into the existing estuary.

In addition to the erosion of sediment in the tidal channel, peak flow events in the Taylor River would result in erosion of the fairly unconsolidated, fine-grained sediment from the parts of the area of the impoundment outside of the tidal channel (*i.e.,* the tidal marsh). Hydraulic modeling suggests that during a 100-year storm, water will flow within the footprint of much of the current Taylor River Pond. Flow velocities would exceed those estimated for the erosion of unconsolidated fine-grained sediment**.** Therefore, as a worst-case scenario, a portion of the accumulated sediment (77,000 cubic yards) could be mobilized from the current footprint of the impoundment and transported into the estuary.

These scenarios of sediment mobilization from the tidal channel and tidal marsh assumes the following:

- Vegetation has not yet started to grow on the exposed floor of Taylor River Pond, stabilizing the sediment;
- During construction, no mitigation measures were put in place to stabilize the exposed sediments;
- None of the sediment from the impoundment was excavated and disposed of off-site;
- The causeway for Towle Farm Road does not act as a partial block to sediment erosion from the upper impoundment; and
- Sediments have a high water content and are only partially consolidated. The physical properties will need to be examined further to develop a more definite volume of sediment that would be eroded.

As a result, appropriate sediment mitigation is required for Alternative C. As for Alternative B, the recommendations in the Sediment Management Plan (**Appendix D**) were developed to minimize the mobilization of impaired sediment, as requested by the NHDES. In essence, the management plan recommends removal of accumulated sediment from the currently submerged tidal channel within the lower impoundment, following the determination by the NHDES on March 19, 2008 and June 23, 2009. Removed sediment would be disposed at an offsite location (either a landfill or a location in the vicinity of Taylor River Pond, as discussed further in **Appendix D**). In addition, various steps would be undertaken to stabilize the sediment in the tidal marsh to avoid or minimize erosion of sediment in the downstream estuary.

We recommend refining the Sediment Management Plan after a preferred alternative has been chosen and a specific construction approach has been developed. The goal of such refinements should be to further reduce the volume of sediments that is transported into the downstream estuary in a manner that is both (a) environmentally sound, and (b) cost-effective.

3.4 Groundwater Resources and Wells

This section was prepared by Berger's subcontractor GEI, and represents a summary of their letter reports from October 23, 2007 and July 6, 2009 (attached as **Appendices C** and **E**).

3.4.1 Existing Hydrogeologic Conditions

A review of the bedrock and overburden geologic maps of the area and 1948 borings conducted by NHDOT indicate that the Taylor River is underlain by fine-grained fluvial silt and clay sediments (**Appendix C**). Beneath the fine-grained fluvial sediments lie dense sand and gravel with some silt/clay and then bedrock. The fluvial sediments are likely to have low hydraulic conductivities, especially in the vertical direction. These low hydraulic conductivity materials generally inhibit the ability of water to flow vertically between the surface waters and bedrock. GEI also believes that the basal flow of freshwater in bedrock toward the estuary and ocean and the associated freshwater lens overlying the salt water wedge will limit the potential for intrusion of saltwater into the overlying freshwater zone in the bedrock.

Based on studies conducted along coastal areas in New England **(Table 2** in **Appendix C**), saltwater intrusion at this site is unlikely due to these geologic conditions and the likely low pumping rates associated with residential potable water usage. These studies indicate:

- Little to no saltwater intrusion occurred beyond ¼ mile inland from the ocean; and
- Significantly impacted bedrock potable water supply wells were usually within 200 feet of the ocean and had a direct hydraulic connectivity through bedrock to the ocean.

3.4.2 Water Supply Well Data

To evaluate the potential effects of the proposed project on the wells, GEI obtained available information on the locations and depths of the wells near the Taylor River Pond, and whether the wells are screened in soil or bedrock. Per discussions with representatives of the Towns of Hampton and Hampton Falls, there is no public water service in these towns. The only private water company is Aquarion Water, which serves parts of Hampton. Aquarion's service does not extend west of I-95. Therefore, based on collected information, all water supplies in areas potentially affected by the project are provided by private household wells and community water supply wells.

Since 1984, the State has required submittal of installation data for new water wells, and the NHDES maintains a database of this installation data. In general, the State does not have information on wells installed before 1984, except for wells that are used as public water supply or community wells. Some of the installation data in the State's database has been incorporated into the NHDES GIS system. GEI obtained updated information from the NHDES on water supply wells installed since 1984.

The GIS map provided in **Figure A1** in **Appendix E** shows the private wells located within the study area, generally within ¼-mile of the Taylor River Pond. **Tables 1** and **2** in **Appendix E** show the data summary for wells that are listed in the NHGIS general database for Hampton and Hampton Falls,

respectively, and appear to be within ¼-mile of the pond. Some of the well location information is missing, so some of the wells included in these tables may be more than ¼ mile from the pond.

There are wells within ¼ mile of the Taylor River Pond that are not listed in these tables, either because they were installed before 1984 or because the required well installation logs were not submitted to the State. To obtain additional information, GEI visited the Assessor's Office in both Hampton and Hampton Falls to obtain tax maps and generate a list of properties from assessor's records. Property records were also available online for the town of Hampton through the Vision Appraisal website. **Table 3** in **Appendix E** lists properties in Hampton and Hampton Falls that are located within our study area.

GEI prepared a questionnaire to property owners within the study area, including those residents serviced by community wells, to request water supply well information, including the location and depth of the well, the depth of the water below the ground surface, and any analytical test data on water samples from the well. Using the tax assessor's records for Hampton and Hampton Falls, GEI assembled a list of 248 property owners within ¼ mile of the Taylor River Pond, 118 of which are property owners that obtain their water from community wells. The NHDOT sent out the questionnaires to all of the property owners under their letterhead on May 1, 2009. Of the 118 owners who rely on community wells, 24 responded, and of the 130 other owners, 59 responded. Copies of the returned questionnaires are included in **Appendix E**.

Wells being used for public/community water supply are regulated by the State, regardless of the date of installation of the wells. Well locations and laboratory test data are available from the NHDES's "One Stop Program GIS" website. **Figure A2** in **Appendix E** depicts the public water supply well locations from the website, and well data from the website are provided in **Appendix E**. Three active wells (2 wells serving Taylor River Estates and 1 serving the Hemlock Haven mobile home park) are located within ¼ mile of Taylor River Pond. GEI understands that a new well has recently been installed for Hemlock Haven, but is not yet in service.

The community wells and all of the water supply wells in **Appendix E** are identified as bedrock wells. The well depths supplied by the property owners in the questionnaires are nearly all great enough that the wells would extend far into bedrock. GEI expects that wells in the vicinity of the Taylor River for which they do not have information are also typically drawing water from the bedrock and not the overburden. Based on collected data, we expects that the bedrock wells draw water from deep regional bedrock groundwater flow that trends southeast toward the ocean and trends locally toward the estuary. Typical household potable water supply wells in bedrock draw in water at a low rate, because the water contained within the well acts as storage, allowing for a slow, steady flow of water during pumping conditions. Consequently, GEI does not expect a large radius of influence with most of the bedrock wells.

GEI contacted the operators of the community wells to obtain information on typical water withdrawal rates for those wells, but that information was unavailable.

Although none of the wells are specifically indicated to be overburden wells, several of the well depths given in the responses to the questionnaire are small enough that these wells may obtain their water from the overburden rather than the bedrock. Also, one of the property owners indicated that when the level of the Taylor River Pond is low (such as during particularly dry periods or when water is released from the pond), the quantity and quality of their well water decrease. This suggests the possibility of a direct connection between the pond and the well.

A number of the well owners provided analytical data for samples taken from their wells. GEI obtained analytical data for the community wells from the GIS website. None of the data included measurements of salinity, but the concentrations of chloride in the samples were all below EPA drinking water standards

and generally well below those standards. This indicates that saltwater intrusion has not occurred to date at these well locations.

GEI also contacted seven local well drillers in the Towns of Barrington, Dunbarton, Henniker, Merrimack, Rollingsford, Sandown, and Stratham, New Hampshire to obtain general information on the wells in the area. None of the representatives GEI spoke to had experience directly within the study area. However, one driller indicated that well depths in the Seacoast area were often about 200 feet, that subsurface conditions encountered generally included clay overlying bedrock, and that yields were typically between 10 and 50 gallons per minute at this depth. Reportedly, no saltwater has been encountered during drilling activities.

3.4.3 Impact Analysis

3.4.3.1 Alternative A

The "no action" alternative for the existing I-95 embankment and Taylor River Pond spillways will have no impact to the existing wells in the project area. Failure of the existing spillway(s) would create, in the short term, a condition similar to Alternative C, for which GEI expects only minor impacts. Repair or replacement of the spillways after failure would restore the existing conditions.

3.4.3.2 Alternative B

Replacing the existing spillways with a wider one at the same elevation as the existing primary spillway should result in no significant change in surface water elevation in the impoundment, except under high flow conditions. Therefore, there would be little to no impact to the surrounding wells.

3.4.3.3 Alternative C

Because the spillways act as a boundary between the freshwater of the Taylor River and seawater of the Atlantic Ocean, removal of the Taylor River Pond spillways would permit the tidal seawater to travel up to approximately 0.6 mile upstream to the Towle Farm Road Bridge, and possibly as much as 1 mile upstream to the Rice Dam. A number of potable water supply wells are located near this stretch of the river, so GEI evaluated the potential for saltwater intrusion to affect these wells following construction of the bridge and removal of the spillways.

If the Taylor River Pond spillways are removed, the width of the estuarine tidal area beyond the I-95 embankment location would be limited by the topographic contours within the Taylor River. The relatively small area covered by the new estuary limits the potential for the Taylor River to become a source of water flow into the underlying overburden and bedrock. In addition, the low hydraulic conductivity of existing glacial marine and fluvial sediments and glacial till would restrict flow of water vertically between the estuary and bedrock.

Based on topographic relief and the limited available information regarding elevation of water in the bedrock wells near the Taylor River Pond, it is expected that water levels in the bedrock are high enough to prevent the flow of estuary water to the bedrock wells, possibly except for the community wells and for wells located very close to the Taylor River Pond (perhaps within 200 feet).

For the overburden, it is expected that in general, the overall flow within the system would be from the freshwater in the overburden into the estuary, thereby inhibiting saltwater intrusion into the overburden aquifer and minimizing the potential effects of lowering the pond on overburden wells. However, anecdotal information from one of the well owners in the questionnaire response indicates that previous lowering of the pond has negatively impacted their well, which is located within 30 feet of the pond. The suggestion in the questionnaire response was that this has happened on multiple occasions. The depth of

this well or whether it is an overburden well is not known. It is suspected that it is an overburden well, given that their well responded significantly to short-term changes in the pond level.

The available information regarding the wells in the study area indicates that there are few overburden wells. The GIS information indicates that the depth to bedrock is less than 50 feet in nearly the entire study area. Of the well depths listed in the GIS data and reported in the questionnaire responses, only 6 were less than 100 feet, suggesting that there are very few overburden wells. Also, based on the well depths reported in the questionnaire responses, nearly all of the wells close to the pond are bedrock wells. However, many of the questionnaire responses did not include well depth.

In summary, based on a review of published studies and existing project information, GEI does not anticipate that removal of the spillways would affect the usability of potable water supply wells that draw water from bedrock. Although unlikely, it is possible that individual wells may be connected via bedrock fractures in a more direct way to the Taylor River than is currently known. This scenario is unlikely, because saltwater intrusion rarely occurs this far inland in New England. In general, public/community water supply wells are more likely to be affected than household wells, due to the higher rate of pumping that could draw water from a greater distance. Some of the information obtained from the property owners suggests that a few wells close to the Taylor River Pond may draw water from the overburden. Wells drawing water from the overburden may be more susceptible to negative effects of lowering the pond, either from salt-water intrusion or reduction in recharge from surface infiltration. However, as discussed above, it is expected that there are very few of these wells.

3.5 Infrastructure

Based on information reviewed for this study, there are no utilities or structures, other than the existing I-95 bridge, the Taylor River Pond primary spillway/fishway, and emergency spillway/culvert that will be impacted by the proposed project. However, the peak flow velocities at the Towle Farm Road bridge will likely increase if these structures are removed (Alternative C). Therefore, it is recommended that the impact of higher velocities on the structure footings and abutments be further evaluated during the design phase, should this alternative be selected.

3.6 Fire Fighting Water Supply

3.6.1 Existing Conditions

A fire “dry hydrant” is located on the northwest side of the Towle Farm Road crossing of the Taylor River, in Hampton Falls. This hydrant is used as a water supply for fire trucks. According to July 2008 conversations with the Town of Hampton Falls Fire Chief, the truck pumps have a maximum 15-foot lift capacity, and there have been no problems associated with this hydrant reported. Plans for this installation are not available.

According to the Town of Hampton Fire Chief, there are no dry hydrants on the Hampton side of Taylor River Pond.

3.6.2 Impact Analysis

3.6.2.1 Alternative A

If the existing Taylor River Pond spillways were to remain in-place, the impoundment would also remain. Therefore, the dry hydrant would remain operable. However, if the deteriorated spillway(s) failed, the impoundment would be drained to some unknown elevation, based on the extent of the spillway structural

breach. Fire protection from the pond would potentially be impaired following a spillway failure, until repairs were completed.

3.6.2.2 Alternative B

There are minimal variations in surface water elevations between Alternatives A and B. Therefore, there would be no adverse impact on the hydrant's ability to provide adequate water to the fire truck.

3.6.2.3 Alternative C

Under this alternative, Taylor River Pond would essentially be drained, and at normal flows, only small pockets of pooled water will remain. The pond area will be inundated with daily tides; however, there will not be enough storage for use with the aforementioned dry hydrant.

Based on meetings with the Hampton and Hampton Falls fire chiefs on July 2, 2008, two 100,000 gallon underground, concrete fire cisterns would need to be installed to service the residences should this alternative be selected. One cistern would be installed on State-owned property located northeast of the Towle Farm Road crossing of Taylor River (Tax Map 137/Lot 2-A); the other would be constructed at the corner of Towle Farm Road and Brown Road, south west of Taylor River (Tax Map 5/Lot 51-3A). Each cistern would be constructed with appropriate dry hydrant equipment, a gravel or paved fire truck pull-off area, and concrete-filled bollards for traffic protection.

3.7 Socio-Economic Issues

3.7.1 Public Involvement

Two publicly advertised meetings were held with the Select Boards of Hampton (October 16, 2006) and Hampton Falls (November 15, 2006) to introduce the project and identity concerns associated with potential alternatives. There was also a neighborhood meeting at the Boynton's residence, Taylor Estates, on October 11, 2006. Major issues raised during the meetings included potential opportunities to reduce existing flooding problems, potential negative impacts to recreational uses (*e.g.*, fishing and boating) and waterfront property values with the loss of the impoundment, and concerns regarding existing water quality.

In addition to the public meetings, a recreational use survey was completed by 30 individuals and/or households surrounding Taylor River Pond. The survey included a question regarding observed water quality problems, which identified excessive plant/algae growth and foul odors. Twenty of the 30 respondents indicated that they had experienced problems with flooding. The majority of the respondents (23 of 30) were not interested in better public access to the impoundment.

A public informational meeting was held on October 29, 2007, at the Hampton Falls town offices to present the preliminary Draft Feasibility Study results, to obtain further public input and to relay the next steps of the project process. Major issues raised during this meeting included, but were not limited to: the aesthetics with the spillways removed and will the exposed intertidal flats have an odor; the potential impacts to the current fishing environment and other pond recreational activities; potential impacts to property values; and potential impacts to the water table, drinking water wells, and dry hydrants.

Additional Public Informational meetings were held in Hampton Falls on November 10, 2009, in Hampton on March 1, 2010, and in Hampton on June 21, 2010. The intent of the meetings was to present the revised Final Draft Feasibility Study and obtain additional public input, prior to finalizing the document.

3.7.2 Open Space

Approximately 155 acres of Hurd Farm, straddling the Taylor River in Hampton and Hampton Falls, is protected open space through an agricultural preservation agreement. The agreement, which is held and monitored by the Rockingham County Conservation District, also provides for permanent public recreational access. Funding for the project was a combination of local bond measures, and grants from the federal Coastal and Estuarine Land Conservation Program (CELCP), the USDA Federal Farmland and Ranchland Protection Program (FRPP), and New Hampshire's Land and Community Heritage Investment Program (LCHIP). No federal Land and Water Conservation (6[f]) funding was involved with this purchase. Any potential impacts on properties acquired with 6(f) funds are strictly regulated by the Land and Water Conservation Act. Based on communications with local officials, no other conservation lands abut the impoundment.

3.7.3 Impact Analysis

3.7.3.1 Alternative A

There would be negligible adverse or beneficial short-term impacts with regard to socio-economic issues including property values. Adverse impacts would arise from spillway failure were the structures to fall into further disrepair from lack of maintenance. In addition, if no corrective actions are taken to improve water quality within the pond or watershed, eutrophic conditions will continue and potentially lead to long-term negative impacts. The risk of flooding under this alternative for properties bordering the impoundment presents a further adverse impact.

Should the deteriorated spillway(s) fail, the impoundment would be drained to some unknown elevation, based on the extent of the structural breach. Damage to the land surrounding the primary spillway, as well as to I-95/earthen embankment, could occur due to structural failure. Fish resources and recreational usages of the pond and associated socio-economics would also be adversely affected until the structure(s) were repaired.

3.7.3.2 Alternative B

A properly constructed and maintained bridge and spillway/fishway structure will last many decades. Therefore, the improved fishway should have a positive impact on socio-economics if the river herring runs improve, resulting in larger river herring populations in coastal New Hampshire waters and in the Taylor River and increased utilization of river herring and associated fishery resources (freshwater game fishes in the pond). If, however, water quality conditions in the pond degrade in the future as a result of increased eutrophic conditions, these conditions may offset benefits gained by the improvements in fish passage to the pond.

Additional water quality deterioration in the future could adversely affect the property values over the long term. However, over the short term, no adverse impacts with regard to property values are anticipated.

This alternative will also have adverse impacts as taxpayers or another owner would need to fund the construction of a new spillway and fishway as well as maintain the structures over the long term.

3.7.3.3 Alternative C

The removal of the Taylor River Pond spillways will substantially alter the current habitat characteristics, recreational uses, and scenic views by elimination of the existing impoundment. An assessment of potential impacts on property values is pending further analyses by NHDOT appraiser staff. The existing freshwater aquatic habitat (*i.e.*, the pond) would be converted to intertidal flats and salt marsh, as well as

fringing brackish and/or freshwater wetlands, with the narrow Taylor River flowing through the wetlands. The conversion into tidal wetlands upstream of I-95 would benefit the entire downstream estuarine ecosystem through the restoration of former “run-of-river” habitat. The community at-large would also benefit from an increased environmental awareness regarding habitat restoration efforts. The issue of low dissolved oxygen would be eliminated as the impoundment would no longer exist. The loss of the impoundment would likely affect residential shoreline property values.

NHDOT conducted a study relative to impacts to the property values with Alternative C. The report evaluated the River Willow and the Taylor River Estates neighborhoods. A full copy of the report is included in **Appendix F**. The report estimates that a decrease in property values of approximately 5% may be realized for the River Willow neighborhood and approximately 20% may be realized for the Taylor River neighborhood properties directly abutting the water.

3.8 Recreational Use

3.8.1 Existing Conditions

To aid in the identification of important recreational uses of the Taylor River Pond, a Recreational Use Survey was conducted in October 2006, which targeted direct abutters and neighborhoods within sight of the impoundment (**Appendix G)**. Of the approximately 55-60 residences visited, surveys were completed by 30 individuals and/or households. Based on the results of the survey along with observations during data collection and input from local officials, the important recreational uses of the pond, include boat and shore fishing, swimming, boating (canoes and kayaks), and scenic/wildlife viewing (**Figure 30).** Passive recreational uses of scenic and wildlife viewing were the most commonly cited uses by abutters to the Taylor River Pond.

Other uses identified by respondents but not specifically included on the questionnaire included ice fishing, snowmobiling, and skating. When asked about the number of days respondents participated in recreational activities, the activities were equally distributed across all four seasons. This finding further confirms the importance of winter-based recreational activities within the pond.

It is noted that the limited survey does not provide a regional context of current recreational use of the area. The Hurd Farm access can accommodate approximately 15 vehicles. This access affords an excellent opportunity for those who are not direct abutters or residents in the adjacent neighborhoods.

3.8.2 Impact Analysis

3.8.2.1 Alternative A

There would be no immediate effect on existing recreational uses within Taylor River Pond under this alternative. Anadromous or resident freshwater fish populations would remain unchanged. On a longer term basis, however, if no repairs were made to the existing fishway, it would continue to deteriorate and result in lower anadromous fish passage efficiency. The reduction or elimination of the herring run from Taylor River Pond may also affect the resident game species in that less forage (juvenile herring) would be available. This adverse effect to the existing sport fishery could impact boat, shore, and ice fishing opportunities. In addition, if no corrective actions are taken to improve water quality within the pond or watershed, eutrophic conditions would continue and potentially lead to far-term negative impacts to boating, swimming, scenic open water views, and fishing.

If the current pattern of eutrophication of the pond was to continue into the future (assumes that no actions are taken to reverse the current trend), the concentration of submerged and emergent aquatic vegetation would increase. This would result in reduced boating opportunities in the pond and reduced

aesthetics (open water views) during the summer months, when vegetation would be most concentrated.

Also, should the deteriorated spillway(s) fail, the impoundment would be drained to some unknown elevation, based on the extent of the structural breach. Damage to the land surrounding the spillway/fishway, as well as to I-95/earthen embankment could occur due to a breach. Fish resources and recreational usages of the pond would be adversely affected until the structures were repaired.

3.8.2.2 Alternative B

The improved fish passage associated with this alternative would have a positive impact on boat, shore, and ice fishing, if the number of forage fish (juvenile herring) for the existing warm water game species increases as a result of increased numbers of herring reaching the pond through an improved fishway. However, the existing eutrophic conditions in the pond would continue or increase over time (without corrective actions), which would have adverse effects on other recreational uses such as boating.

3.8.2.3 Alternative C

Removal of the spillways would substantially alter the current habitat characteristics. The existing freshwater aquatic habitat would be converted to a small freshwater stream meandering through intertidal flats and salt marsh, as well as fringing brackish and/or freshwater wetlands. The loss of an open water pond would substantially change the types of available water-based recreation within the former impoundment. Boat, shore and ice fishing for freshwater fish species would be nearly eliminated. However, the anticipated changes in habitat conditions would lead to new fishing opportunities for coastal/estuarine species.

The restoration of a tidal creek within the impoundment reach would allow for downstream navigation during certain tide cycles with small watercraft such as kayaks, as well as for scenic and wildlife viewing (especially shorebirds) of a different type of habitat (tidal creek and surrounding marsh).

3.9 Water Quality

3.9.1 Existing Conditions

Concern was expressed by the NHDES during early project coordination regarding the potential for low dissolved oxygen (DO) levels within the Taylor River Pond, which could negatively affect fish populations and other aquatic resources. Field observations in the fall of 2006 documented an abundance of submergent and floating vascular plants along with filamentous green algae in many locations. This suggested an abundance of nutrients in the pond. Low DO concentrations were suspected (and previously reported by the NHFGD) in the deeper areas of the pond during the summer months as a result of stratification (the more oxygen-rich upper layer of the water column fails to mix with the deeper oxygen-deficient layer). The deeper area of the pond, however, constitutes a relatively small portion of the total pond area.

The relative shallow and stagnant nature of the pond with its abundance of aquatic plant life suggests eutrophic conditions. The high organic content of the sediment indicate recycling of nutrients back into the water column. Decaying organic matter also reduces the dissolved oxygen content and can cause impacts to other organisms.

To address concern about dissolved oxygen, NHDES deployed a multiprobe datasonde in 12 to 15 feet of water just upstream of the Taylor River Pond primary spillway from August 31 through September 5, 2006, when the water temperature was still relatively warm (over 20°C). NHDES also recorded a

temperature/DO profile on August 31 to a depth of 12 feet. Both the datasonde and the DO profile indicated "typical" summertime conditions for a warm water eutrophic pond. The datasonde recorded DO levels generally between 7.0 and 9.0 milligram per liter (mg/l), with a low reading of 5.7 mg/l, well above the state water quality standard for Class B waters of 5 mg/l (**Figure 31**). The DO profile showed relatively high DO levels above state standards from the surface to a depth of 6 feet, with decreasing levels at greater depths to a low of zero DO at the bottom (**Table 16**).

More in-depth DO and nutrient monitoring was conducted in the Taylor River Pond between May and October 2008 (Berger, 2008). Monitoring included vertical profiles at 12 stations throughout the pond during eight sampling events from May to October, as well as continuous monitoring at two stations over 23 days. Water samples for nutrient and chlorophyll *a* analyses were obtained mostly from the upper water column. The *Dissolved Oxygen and Nutrient Conditions in Taylor River Pond* report (Berger, 2009) is included in **Folder 4** of the Additional Data CD.

In summary, the 2008 study found that DO concentrations decrease during the summer well below the regulatory limit of 5 mg/l (**Figure 32**). Lowest concentrations exist in the deeper part of the former river channel; the channel reaches depths of over 10 feet. However, there was considerable spatial variability in the dissolved oxygen concentrations throughout the pond in the summer. This spatial variability could be a result of limited horizontal water exchange due to the shallow water depth in the pond and the dense aquatic vegetation. Other factors are likely freshwater inflow during rainstorms and varying degrees of mixing from wind action in different parts of the pond. The depth of the oxycline (*i.e.*, the interface between zones with higher and lower dissolved oxygen concentrations) appears to fluctuate vertically over time, possibly for the same reasons that cause the spatial variability (**Figure 33**).

Based on nutrient sampling, the limiting nutrient appears to be phosphorus rather than nitrogen, which means that phosphorus concentrations control the degree of growth of the aquatic vegetation. Total phosphorus concentrations were elevated and typically in the eutrophic range (**Table 17**). Chlorophyll *a* concentrations ranged from mesotrophic to eutrophic during the different sampling events. Overall, the low dissolved oxygen concentrations, elevated nutrient concentrations, as well as the high density of floating and submerged aquatic vegetation in the Taylor River Pond verifies eutrophic conditions in the pond in the summer, which has been previously reported.

A pressure transducer and salinity sonde were deployed within the Taylor River downstream of I-95 between September 26 and November 3, 2006 (**Figure 34**). Salinity levels reached 27 parts per thousand (ppt). During periods of high rainfall, the salinity measured at this station was 0 ppt (*i.e.*, freshwater). The salinity data as well as historic topographic maps indicate that an estuarine system would be supported upstream of I-95 if the Taylor River Pond spillways were removed.

3.9.2 Impact Analysis

3.9.2.1 Alternative A

If no action is taken to repair the I-95 bridge and Taylor River Pond spillways, there would be no change in the Taylor River Pond and existing water quality conditions. If no corrective actions are taken to improve water quality within the pond or watershed, eutrophic conditions would continue and potentially result in additional water quality impairments in the future.

However, should the deteriorated spillway(s) fail, the impoundment would be drained to some unknown elevation, based on the extent of the structural breach. This would return the impoundment reach to a riverine habitat without eutrophic conditions, until the structures were repaired.

3.9.2.2 Alternative B

Because the elevation or the operation of the pond is expected to remain unchanged from existing conditions, water quality conditions would be similar to Alternative A, and as noted in Alternative A, there could be additional water quality impairments in the future.

3.9.2.3 Alternative C

The current pond would be eliminated and this reach of the Taylor River would return to a free-flowing coastal stream, likely affected by tidal flows upstream of the I-95 bridge well into the current location of the Taylor River Pond. This would eliminate the shallow eutrophic pond that currently experiences low DO conditions during the summer. After spillway removal, some sediment currently accumulated in the pond would be mobilized and pass downstream as the Taylor River re-establishes a channel within the former pond bed. Once this channel is established, the water quality would likely return to conditions typical of coastal New Hampshire streams within the tidal zone, experiencing fluctuations in water levels and salinity depending on river flow and tidal flows. Water elevations in the Taylor River downstream of the I-95 bridge ranged from about -3 feet to 7 feet NGVD29, indicating that tidal flows would reach well into the former pond (**Figure 35**); the existing primary spillway elevation is at 8.55 feet. The water in the former pond would range from saline to brackish, depending on the amount of rainfall in the Taylor River watershed (**Figure 36**). The current low DO conditions observed in the pond would no longer occur because the Taylor River would revert to a shallow coastal stream dominated by tidal flows without permanent ponding of the water.

3.10 Fisheries

Several sources were researched for historical information and maps regarding natural resources in and along the Taylor River. The primary source of historical information was the Lane Memorial Library, Hampton, NH, website. The NHFGD was also contacted for more recent information (since the 1970s), which included annual anadromous fish reports and annual fish stocking records. The NHFGD also provided a one-page report on the water quality and the fisheries of the pond in 1954. Local property owners on the Taylor River Pond were also interviewed during Berger's site visits, relative to natural resources in the area.

3.10.1 Existing Conditions

3.10.1.1 Recent Diadromous[13] Fisheries Information

The NHFGD provided anadromous fish reports for coastal New Hampshire for 2004, 2005, and 2009, and a 2001 data report on American eel sampling in the Taylor River Pond Dam fishway. These reports indicated that the Taylor River has had a large river herring run (blueback herring and alewife) in years past, but in recent years the run has declined substantially. The NHFGD indicates that the Taylor River is one of two coastal rivers (the other bring the Exeter River) where the spawning runs have indicated a consistent decline over time (**Table 18**).

Two of the lowest river herring counts over the past several years occurred in 2005 and 2006. The NHFGD believes that the lower 2005 and 2006 counts were influenced by high flows that occurred in both springs, including the "Mother's Day Flood" of May 15 and 16, 2006. Counts from 2006 were the

[13] Diadromous species include both anadromous and catadromous species, and are migratory species that historically and currently support important commercial fisheries. River herring are two of the species currently managed by the Atlantic States Marine Fisheries Commission (ASMFC) under the "Fishery Management Plan for Shad and River Herring (*Alosa, spp*.)." The ASMFC also manages the American eel under the "Interstate Fishery Management Plan for American Eel."

lowest counts recorded on all the New Hampshire coastal rivers (combined) since the 1970's, before many of the existing fishways were in operation, with only 147 fish recorded at the Taylor River fishway (although others may have passed upstream undetected). Taylor River fishway counts in 2007 (when the counter was inoperable for 2 weeks) and 2008 were 217 and 976 fish, respectively. The 2008 count was the highest return since 2004.

According to the NHFGD, the species composition of the river herring run is now 95% to 100% blueback herring, although in the early 1990's the run was about 80% blueback herring and 20% alewife, which is a pond spawner (based on communication with the NHFGD on November 6, 2006). In 1976 and 1979, the NHFGD reported that 67 and 99% of the run, respectively, comprised alewife, indicating that there has been a decline in the alewife portion of the run over time, and that spawning conditions in Taylor River Pond may also have declined over time.

The NHFGD also reports that catadromous American eel "elvers" (juvenile eels) migrate upstream in the Taylor River, and that the elver run in the river may be larger than in other New Hampshire coastal rivers. Most years when the NHFGD first prepares the fishway for operation in early spring, hundreds of thousands of elvers must be netted out of the fishway and passed upstream, before fishway operation begins. The NHFGD also hangs a mesh substrate over the primary spillway for upstream eel passage, although passage is not monitored (per communication with the NHFGD on February 6, 2006).

In 2001, the NHFGD placed an "Irish elver ramp" in the fishway to sample the upstream migration. During sampling that occurred from April 22 to June 4, 2001, hundreds of elvers, both "glass" and "brown" stages, were collected. The highest collections occurred in late-April and early-May 2001.

The NHFGD did not report the passage/presence of any other anadromous species in the Taylor River.

The Taylor River may be one of the better systems in the Hampton/Seabrook Estuary with potential for fish restoration because the river has fewer passage barriers than the other rivers, although water quality issues remain. As a result, it is a restoration priority for the NHFGD, which has been working to restore anadromous fish populations to the Taylor River for more than 30 years. Restoration actions have included installing the existing fishway; eliminating in-river harvest of river herring; monitoring fish movement over the fishway; and even netting fish by hand and transporting them over the Taylor River Pond primary spillway.

3.10.1.2 Fish Passage and Potential Upstream Anadromous Fish Habitat

The existing fishway was inspected on September 26, 2006. There was no flow observed through the emergency spillway on the day of the inspection, but there was some flow occurring over the primary spillway, with a flow estimated to be 3 cfs. There is a downstream fish passage chute in the middle of the spillway sheet piles, which was passing water but also appeared to be partially clogged with branches and other woody debris.

The Denil fishway at the existing primary spillway was closed off at the upstream end with stop logs, but there was some leakage flow passing down through the fishway. The water depth at the upstream end of the fishway (in the pond) was approximately 2 feet. As described above, the fishway structure showed signs of concrete erosion at the downstream end, and the steel gratings and access ladder were rusty and corroded.

When the fishway is operating, attraction flow from the fishway enters the narrow channel below the Taylor River Pond primary spillway at right angles to the flow of the river, a considerable design deficiency according to current design standards of the USFWS. Fishway attraction flows should be

parallel to river flow. Immediately downstream of the Dam, any significant flow over the primary spillway obliterates the attraction flows from the fishway, making it more difficult for fish to locate the entrance. The NHFGD, however, reports that the fishway does continue to pass fish, even with these noted deficiencies, and the agency has not observed large concentrations of fish delayed downstream of the primary spillway. Any improved fishway design will still require modification of the Taylor River Pond spillway and bridge to provide sufficient space for an improved entrance configuration to meet current design standards.

Downstream of the Taylor River Pond primary spillway and fishway, tidewater extends up to the face of the primary spillway and to the fishway entrance. The tide was relatively low at the time of inspection. There were several riffle areas in the relocated Taylor River channel below the primary spillway, but these riffles are inundated at higher tide levels.

The upstream tributaries and the Taylor River upstream of the Taylor River Pond were inspected for potential anadromous fish spawning habitat. Grapevine Run enters the pond from the southwest and is the largest tributary to the pond. Grapevine Run was observed at the Brown Road crossing and at Swain Drive near the equestrian center. Below Swain Drive, the stream is backwatered from the pond and is narrow and slow-moving. Flow was estimated at about 0.4 cfs on the day of the inspection (September 26, 2006). During the spring, however, higher flows would likely create higher-velocity run conditions and more wetted area and potential herring spawning habitat. Upstream of the Brown Road crossing, the stream was also narrow but with small riffles. The breached remains of a grist mill dam were observed just upstream of Brown Road. The breach leads into an old stone culvert, which is covered by flat boulders. The large wetland above the breached dam contains a small open water area and may provide limited river herring spawning and nursery habitat potential. Without modification to the remains of the former grist mill dam, however, access to the limited spawning habitat above the dam site is likely precluded. The stream flows under Brown Road through two culverts.

Downstream of Brown Road, Grapevine Run is very narrow, and flows quickly through a riffle area to a pipe intake structure, which leads to a small off-stream pond that is used as a source of water for the Fire Department. The narrow stream flows around the perimeter of the pond embankment. Grapevine Run was not observed downstream of the off-stream pond, as the property was posted.

Based on the small size of Grapevine Run, and the barrier at the old grist mill dam, the stream may provide limited river herring spawning habitat, although higher spring flows would enhance any available habitat.

Rice Dam, the next upstream dam on the Taylor River, is constructed of boulders with a concrete cap and abutments made of rock and concrete. It is an obvious barrier to river herring migration, although with the leakage through the dam, is likely passable by American eel elvers. No water was flowing over the dam during our inspections, but was flowing through cracks and crevices. The dam continues to function as a water control structure, with a small pond upstream of the dam. There are several narrow channels (mostly riffles) between the dam and Old Stage Road, where the stream becomes a defined channel before it is backwatered by the Taylor River Pond. An in-depth assessment of existing structural conditions would be needed to accurately evaluate fish passage options at the Rice Dam. Berger did not inspect habitat conditions upstream of the Rice Dam pond.

3.10.1.3 Existing Habitat Conditions and Resident Fishery

The Taylor River Pond is a relatively shallow, 47.5-acre pond, generally less than 10 feet deep, and is eutrophic with a heavy growth of submerged and emergent vegetation. In late summer, much of the water surface is covered with duckweed and other submerged vegetation and there are usually few areas of open

water. The NHFGD reports low DO levels and that fish kills have occurred in the pond, although we were unable to locate specific fish kill data. Water quality sampling results from 1954, 1986, 2006, and 2008 show similar results. The surveys reported heavy growth of vegetation, generally adequate DO levels in surface waters (greater than 5 mg/l in the top 5 to 6 feet of the water column), and low or zero DO levels near the bottom (although the 1986 report did not report low DO near the bottom on August 19, 1986). As discussed in Section 3.9, the 2008 survey reported DO concentrations less than the state standard (5 mg/l) in the deeper part of the former river channel in the downstream portion of the pond, and in other shallower areas of the pond, showing considerable spatial variability in the DO concentrations throughout the pond in the summer. We observed no evidence of stress or mortality of resident or anadromous fishes during the 2008 survey, as fishes will typically avoid areas of low DO and select areas with suitable DO.

The 1954 survey noted that the pond contained largemouth bass, chain pickerel, yellow perch, and sunfish, and mentioned that establishment of an alewife run in the Taylor River should improve forage for game fish in the pond. Interviews with local residents indicate that there is an active freshwater fishery for largemouth bass and pickerel. Other species reportedly caught by local residents include American eel, sunfish (including bluegill and pumpkinseed), brown bullhead, smallmouth bass, black crappie, and yellow perch. During most winters, productive ice fishing areas occur in the downstream portion of Taylor Pond, near I-95 (per communication with a member of the New Hampshire Estuaries Project, University of New Hampshire [UNH], on January 23, 2007).

NHFGD stocking records for the Taylor River indicate that NHFGD typically stocks about 200 catchable-size brook trout every spring (April and May) in the Taylor River Pond (per communication with the NHFGD on November 6, 2006). From 1990 through 1993, 3,000 to 5,000 brown trout were annually stocked in Taylor River in an effort to establish a sea run brown trout fishery, but this effort was abandoned.

In 2007, the NHFGD collected resident fish species in the Taylor River Pond, using electrofishing and gill nets, as part of their efforts to assess contaminant levels in fish that reside in the pond (**Table 19)**. Nine species were collected, with the most common species being the eastern chain pickerel (about 37 percent of the catch), followed by the anadromous river herring (14 percent of the catch), largemouth bass (13 percent of the catch), and pumpkinseed (12 percent of the catch). The species composition is typical of small eutrophic ponds in southern New Hampshire, and is consistent with the composition reported in previous surveys of the pond and interviews with local residents.

Aside from the density of the aquatic vegetation observed within the impoundment, the Taylor River Pond appears to support a healthy community of native warm-water fish, as well as the non-native largemouth bass and smallmouth bass. Several juvenile sunfish were observed in nearshore habitat during our October 2006 inspection of the pond, and frequent swirls from larger fish were evident in front of our boat. Residents reported catching large pickerel (up to 25 inches) and largemouth bass (up to 6 pounds) in the impoundment (per communication with UNH on January 23, 2007). Several anglers using car-top boats were fishing in the pond during our October site visit. Minimal shoreline sunfish and bass (centrarchid) spawning habitat was evident, but this is likely due to encroachment of aquatic vegetation, including algae. During the centrarchid nesting season (late spring and early summer), adult fish guarding the nests would likely keep spawning beds free of vegetation and they would be more readily observed. The abundance of submergent vegetation throughout much of the impoundment offers ideal spawning habitat for pickerel, and optimal nursery habitat for pickerel as well as centrarchids. The paucity of open water habitat could limit the amount of available river herring spawning and nursery habitat, although the pond is mostly free of aquatic vegetation during the spring spawning run. Aquatic invertebrates (including hydrophycid caddisflies and mayflies) were common within the gravel/cobble

riverbed immediately downstream of Rice Dam, an indication of good water quality in this free-flowing section of the Taylor River not under the influence of Taylor River Pond.

3.10.2 Impact Analysis

3.10.2.1 Alternative A

Under this alternative, no immediate effect on anadromous or resident freshwater fish in the pond would be realized. On a longer-term basis, however, if no repairs are made to the existing fishway, it would continue to deteriorate and result in lower fish passage efficiency and eventually may no longer be operational, although NHFGD would likely attempt to maintain a working fishway. If the fishway became inoperable, fish passage into the Taylor River would be blocked, and the river herring run would likely be significantly reduced, with herring restricted to only the short reach of the river below I-95. The reduction or elimination of the herring run from Taylor River Pond may also affect the resident game species because less forage (juvenile herring) would be available. Reduced forage would result in reduced growth rates and potentially lower game fish populations in the pond, adversely affecting the existing sport fishery for these species. These effects could be avoided if the existing fishway is repaired and improved, but the required improvements to the fishway may not be possible without some modification to the existing primary spillway.

However, should the deteriorated spillway(s) fail, the impoundment would be drained to some unknown elevation, based on the extent of the structural breach. Fish resources in the pond would be adversely impacted as a result of the loss of the pond habitat until the structures were repaired. Anadromous and catadromous fish migration may be temporarily restored in the Taylor River upstream of the Dam, depending on the nature of the breach and whether adequate fish passage conditions occurred.

3.10.2.2 Alternative B

This alternative would likely have little effect on the resident fishery. Even though the wider spillway would result in minimal changes in water surface elevation, the effects on the resident fishery may not be measurable.

The diadromous fishery would be affected by the construction of a new, more efficient fishway for upstream passage of river herring. A new fishway should improve the efficiency of fish passage at the site, allowing more herring to reach the pond and any available habitat in Grapevine Run and in the Taylor River below Rice Dam. The extent of fishway efficiency improvements cannot be quantified, but making the existing habitat available to more river herring should result in a long-term improvement to the river herring population, although this may not occur if the number of herring entering the pond exceeds the carrying capacity of the pond. Based on the typical alewife production for established populations in Maine lakes of 1,700 fish per acre (Walton, 1987), a 47.5-acre pond should support a population of about 81,750 herring, assuming there are no other limitations on the system such as poor water quality. Walton's production figures, however, were for alewife, while the Taylor River herring run is now primarily blueback herring. Historically, the Taylor River supported river herring runs of 200,000 to 400,000 fish (mid to late 1970s), although since 1990 the largest run has been about 85,000 fish, with most years well below that value (**Table 18**). It remains unknown whether the historical fish counts in the Taylor River actually reflect production from just the Taylor River, or instead also reflect the overall abundance of river herring along the New England coast, with large numbers of herring ascending the river when the overall abundance is high along the coast. Research has shown, however, that river herring typically return home to their natal stream, so the large runs of the 1970's, which were comprised of mostly alewife, may have mostly represented Taylor River fish spawned in Taylor River

Pond. The recent run sizes are small, so any increase in the river herring run to the Taylor River should be well within the carrying capacity of the system.

Increasing the number of river herring entering the Taylor River Pond through an improved fishway may also affect the existing resident fishery. Initially, any increase in the production of juvenile herring should benefit the resident game species by increasing the forage base, in turn, benefiting the growth and the health of these species. A large increase in the river herring run into the pond, however, may have some adverse effects on the resident fishery. A large production of juvenile herring could affect the zooplankton population in the pond, as a result of “grazing” by large numbers of juvenile herring. Any reduction in the zooplankton population could, in turn, affect the juvenile life stages of resident species, which also utilize zooplankton as a primary food source. This effect, though, may only be seasonal, occurring during the summer months during the peak abundance period for juvenile herring, and would not be a year-round effect. A large influx of river herring may also affect the nutrient cycle in the pond, by the addition of nitrogen and phosphorous as adult post-spawners die and decompose in the pond. Durbin et al. (1979) noted a significant increase in nutrients in a Rhode Island pond as a result of the influx of large numbers of alewife into the pond. For Taylor River Pond, which already exhibits characteristics of high nutrient levels (excessive aquatic vegetation growth), additional nutrients to the pond could increase eutrophic conditions in the pond resulting in greater growth of aquatic vegetation, fewer areas of open water, and eventually reduction in the amount of suitable fish habitat. As we stated above, however, the current small size of the river herring population makes this scenario seem unlikely in the foreseeable future.

This alternative would also eliminate the approximately 400 feet of “new” Taylor River channel downstream of I-95, which was established when the Taylor River Dam was first constructed and the original river channel was filled in. The original river channel would be re-established and the 400 feet of constructed channel would be filled in, which now consists of a pool and a series of riffles and rapids. This channel serves as the current migration corridor to the existing fishway, and may also support some spawning by river herring. This habitat would be lost but replaced by a new channel about 300 feet long that would pass under the new I-95 bridge. Although this new channel would be engineered to pass flows as efficiently as possible, the channel would also include design features (such as velocity shelters) that would ensure that river herring reach the new spillway and fishway and successfully migrate upstream.

3.10.2.3 Alternative C

This alternative would re-establish the Taylor River as a small coastal stream, with estuarine conditions extending into the former pond bed. Anadromous, catadromous, and estuarine species would have full access to the Taylor River up to Rice Dam and up to the old grist mill dam on Grapevine Creek, the tributary that currently enters the lower end of Taylor River Pond. This would be an advantage over the other alternatives that would provide fish passage via a Denil fishway, which is adequate for river herring and some other species passage, but may not be suitable for passage of rainbow smelt and estuarine species. Although the precise size of Taylor River and the nature of the habitat that would be re-established in the current area of the pond are not known, the river would be a relatively small stream, based on the size of the channel observed immediately below Rice Dam. The river would provide spawning habitat for blueback herring, which comprises the majority of the current river herring run, but would be less suitable for alewife, which are primarily pond spawners, although currently do not successfully use Taylor River Pond. The amount of wetted habitat would be significantly reduced from existing conditions, but the habitat would be riverine and subject to tidal flows, unlike the current freshwater pond habitat. Species such as smelt and American eel, which are currently excluded from the Taylor River or hindered in their upstream migrations, would be able to freely access the river. Tidal estuarine species could use the Taylor River, entering and exiting the river during the tidal cycles, utilizing any newly developed salt marsh for foraging and cover. One sport species of high interest along

the New England coast, the striped bass, could be attracted to the Taylor River during the river herring runs and potentially provide a sport fishery in the lower river.

The existing freshwater fishery in the Taylor River Pond would essentially be eliminated with the draining of the pond. Although some of the resident species may continue to occur in small numbers in the restored Taylor River (such as bullhead), those species that prefer or require pond habitat would no longer occur in sufficient numbers to support a recreational fishery. This would include largemouth bass, chain pickerel, and the sunfish species (bluegill, redbreast sunfish, and pumpkinseed). The one species of State concern that reportedly occurs in Taylor River Pond, the banded sunfish, would unlikely occur in the restored Taylor River because of the loss of the pond habitat.

3.11 Listed Species of Concern

3.11.1 Existing Conditions

The USFWS has no federally listed or proposed threatened or endangered species or critical habitat under their jurisdiction at the project location.

The New Hampshire Natural Heritage Bureau (NHNHB) has documented and mapped the occurrences of four state-listed estuarine plant species in two areas of the Hampton River Estuary. The mapped occurrences are located ¾ mile southeast of I-95 and well beyond the limits of the project study area. The NHNHB also reported the occurrence of the banded sunfish (*Enneacanthus obesus*) where Towle Farm Road crosses the pond in 1985. Although banded sunfish is not state-listed, the species is ranked S3 by NHNHB, meaning that the species is "either very rare or local throughout its range (generally 21 to 100 occurrences), or found locally (even abundantly at some of its locations) in a restricted range, or vulnerable to extinction because of other factors." The NHFGD fish collections in 2007, however, did not collect any banded sunfish.

Copies of the USFWS and NHNHB documentation are included in **Appendix H**.

3.11.2 Impact Analysis

3.11.2.1 Alternative A

There would be no impact to the banded sunfish within Taylor River Pond or to the four state-listed estuarine plant species below the impoundment under the No Action Alternative.

3.11.2.2 Alternative B

Impacts to the four state-listed estuarine plant species below the impoundment are not anticipated. An improved fish passage may have a slight benefit to the forage base for the banded sunfish in the form of larval fish. However, the primarily forage base for sunfish is invertebrates.

3.11.2.3 Alternative C

This alternative would substantially alter habitat characteristics by elimination of the impoundment. Existing freshwater aquatic habitat would be converted to intertidal flats and salt marsh, as well as fringing brackish and/or freshwater wetlands. The loss of open water combined with the substantial increase in salinity levels would greatly reduce the amount of suitable habitat for the banded sunfish, with the only potentially suitable habitat limited to the upper reaches of Taylor River immediately below Rice

Dam. This reach, however, may be only marginally suitable with Dam removal because the reach would likely become more riverine in nature.

3.12 Wetlands

3.12.1 Existing Conditions

The Taylor River watershed includes an extensive mosaic of vegetated freshwater wetlands and open water habitat. In fact, four wetland complexes upstream of Taylor River Pond were identified as Prime Wetland candidates under NH RSA 482 (Hampton Conservation Commission and Rockingham County Conservation District, 2004). These areas included portions of the Taylor River in Hampton and Hampton Falls, a portion of Ash Brook and Old River in Hampton and Grapevine Run in Hampton Falls. Below I-95, Taylor River meanders through an extensive salt marsh system associated with Hampton/Seabrook Harbor. Field verification of aquatic resources within the Taylor River Pond during October 2006 by boat, found the embankments to the pond were fairly steep and well defined and lacked a broad transition of emergent marsh and/or wooded wetlands to the upland edge. Historical mapping indicates a meandering tidal creek with estuarine marshes extended well upstream toward Rice Dam prior to construction of the Taylor River Pond Dam.

The wetlands bordering the Taylor River Pond between I-95 and Rice Dam consist of narrow emergent and/or wooded wetland (**Figure 37**). Most of the emergent wetland areas consist of cattails (*Typha* sp.) and are classified as PEMIF in accordance with the US Fish and Wildlife Service Classification System (Cowardin et al., 1979). The majority of the pond consists of extensive beds of submergent and floating vascular plants (L23/4Hh). The deeper portions of the impoundment associated with the center of the former stream channel are limited to submergent aquatic vegetation. In many locations, there was also a layer (sometimes several inches thick) of filamentous green algae evident, suggestive of an abundance of nutrients in the pond. Common submergent and floating vascular plants included floating pondweed (*Potamogeton natans)*, ribbon-leaved pondweed (*Potamogeton epihyhydris)*, big-leaved pondweed (*Potamogton amplifolius)*, common elodea (*Elodea Canadensis)*, yellow pond lily (*Nupar lutem)*, coontail (*Ceratophyllum) demersum*, common bladderwort (*Utricularia vulgaris)*, water buttercup (*Ranunculus flabellaris)*, duckweed (*Lemna* spp.), and wild celery (*Vallisneria Americana).*

Certified wetland scientists delineated the limits of jurisdictional wetlands along both sides of the I-95 corridor on October 19, 2006 for the project area. A narrow band of common wetland shrubs were found along the toe of the roadway embankment and represent the upper limit of jurisdictional wetlands. The wetland boundary along the eastern embankment generally followed the top of bank associated with the existing channel leading to the bridge under I-95 or the edge of a *Phragmites*-dominated marsh along the edge of an extensive salt marsh just downstream. The adjacent salt marsh is associated with Hampton/Seabrook Harbor. The constructed channel leading to the existing primary spillway and the emergency spillway is largely unvegetated and stone-lined to prevent scour adjacent to the highway.

While this existing freshwater wetland complex currently provides a range of wetland functions including floodflow storage, fish and wildlife habitat, and water quality enhancement, impounded wetlands are not viewed as self-sustaining over the long-term. Without corrective actions that address the existing water quality impairments within the pond or watershed, eutrophic conditions would continue and become more widespread over time. Community functions are also impacted by the existing fragmentation of the Taylor River system which is dependent on the free exchange of sediment, nutrients, organic matter and biota with the ocean and a complexity of habitats to be a long-term self-sustaining wetland complex.

A relatively large wetland within the Taylor River watershed is associated with Grapevine Run, located southwest of the Taylor River Pond. This wetland complex lies upstream of the remains of a grist mill

dam. As previously mentioned, this 35-acre wetland complex was identified as a candidate for Prime Wetland designation. The wetland lies significantly higher in elevation (approximately elevation 20 feet) and would not be influenced by any changes in the Taylor River Pond water surface elevation. A large forested wetland located to the west of the I-95 Rest Area also lies within a depression which is substantially higher in elevation than the impoundment and would not be influenced by modifications to the pond water surface elevation.

The downstream estuary provides important shellfish resources. The potential for further degradation of water quality over time within the impoundment could lead to shellfish closures in the future.

The habitats within the impoundment, and consequently many of the wildlife species found there, likely are different today when compared to what existed prior to the construction of the Dam. Much of the change in bird occurrence and use likely has been the result in the change of a system dominated by intertidal flats and cordgrass (*Spartina spp.*) to one that currently is dominated by freshwater vegetation. In addition, without corrective actions to improve water quality within the pond, eutrophic conditions would continue and potentially adversely affect forage fish populations that are important seasonal food resources for many birds. Species common to freshwater marsh and wooded wetland habitat include red-winged blackbirds, song sparrows, prairie warblers, common yellowthroats, and grey catbirds. Many of these species are abundant nesters elsewhere in the region. Restoration within the impoundment would permanently alter the current habitat conditions for some of these species and where it is possible, cause them gradually to shift to appropriate habitats higher in the Taylor River system.

Small mammals, such as mice, voles, and shrews are presumed to be very abundant in the wetlands surrounding the impoundment. Larger mammals, such as coyotes, river otters, raccoons, and deer, also utilize the available habitat. The prevalent mammals in the area are generalists, highly adaptable, and likely to move to adjacent habitat unaffected by tidal restoration.

3.12.2 Impact Analysis

3.12.2.1 Alternative A

There would be no immediate (near-term) effect on existing wetland resources within Taylor River Pond under the No Action alternative, as the water levels remain unaffected. If no corrective actions are taken to improve water quality within the pond or watershed, eutrophic conditions would continue and potentially lead to far-term negative impacts to the wetland system fish habitat and recreation functions. The No-Action alternative will continue to fragment the Taylor River system which is dependent on connectivity and complexity of habitats to be a long-term self-sustaining wetland complex.

3.12.2.2 Alternative B

The improved fish passage associated with this alternative would have a positive impact on the wetland system's fish and wildlife habitat functions as the increase in forage fish (juvenile herring) will benefit the existing warm water fishery and fish dependent wildlife. These benefits would be tempered, however, as water quality conditions would be similar to Alternative A, so there could be additional water quality impairments in the future leading to far-term negative fish/wildlife habitat and recreation functions. The replacement of the spillways will continue to fragment the Taylor River system which is dependent on connectivity and complexity of habitats to be a long-term self-sustaining wetland complex.

3.12.2.3 Alternative C

The removal of the spillway(s) would substantially alter habitat characteristics within the Taylor River Pond. As stated previously, existing freshwater aquatic habitat would be converted to intertidal flats and

salt marsh, as well as fringing brackish and/or freshwater wetlands. Based on measured salinity levels, tidal datums, existing downstream marsh communities and historical mapping, a meandering tidal creek with estuarine marshes would extend well upstream toward Rice Dam.

Estuarine environments are found along the coast where freshwater from rivers and streams meet and mix with saltwater from the ocean and are among the most productive on earth, creating more organic matter each year than comparably sized areas of forest, grassland, or agricultural land. The tidal, sheltered waters of estuaries also support unique communities of plants and animals, specially adapted for life at the margin of the sea. In addition to supporting a variety of wildlife habitat, salt marsh grasses and other wetland plants found in estuaries help prevent erosion through streambank stabilization, provide storm surge protection, and provide vital pollution control for water draining from upland areas. Within the United States, roughly 50% of the nation's coastal wetlands have been lost and even more have been significantly impacted. In New Hampshire, a substantial effort has been expended to restore tidal wetlands which are much less abundant as compared to freshwater wetland habitats. The NH Wildlife Action Plan identifies salt marsh habitat is an important conservation concern because of its many important values and functions. Many birds use salt marsh habitats for breeding, foraging and roosting, including several species of waterfowl, raptors, wading birds, shorebirds and songbirds. Seasonal use of intertidal and salt marsh habitat also varies, with some species using the salt marsh for breeding and others during migration or the wintering period. Salt marshes provide habitat for several species of special concern in New Hampshire, such as saltmarsh sharp-tailed sparrow, Nelson's sharp-tailed sparrow, and willet (NHFGD, 2005).

Under the assumption that the proposed conveyance under I-95 would not restrict tidal flows during spring tide conditions and elevations within the pond are not substantially influenced by sediment losses or decomposition, as much as 21 acres of fringing intertidal salt marsh and flats could be restored (**Figure 12**). Areas within the impoundment above the anticipated elevation of salt marsh habitat (approximately 5.0 feet NGVD29) would likely convert to a mosaic of forested wetland, shrub swamp, freshwater and brackish marsh. This elevation was derived from biological benchmarks within the downstream reference marsh. A detailed estimate of the total amount and types of habitat conversion is difficult to predict due to an array of environmental conditions influencing initial plant establishment and survival. However, the limits of the existing impoundment are not anticipated to convert to uplands and result in a net loss of wetland area. The loss of open water and changes in vegetation communities would substantially alter the types of functions provided by the wetland system. Some wetland functions associated with the artificially created freshwater impoundment would be impacted by the conversion of this habitat type to inter-tidal salt marsh. However, most of the existing wetland community types are anticipated to remain along the perimeter of the former impoundment but to a lesser extent. Restoration of the Taylor River impoundment would restore a long-term self-sustaining estuarine complex. In addition, the downstream estuarine community would benefit from the restoration of former "run-of-river" habitat. The most common group of mammals found in salt marsh habitats in the New England region are rodents, such as the meadow vole, which are an important prey-species for Northern harriers and other raptors. Other common mammals anticipated to benefit from the restoration of salt marsh habitat include red fox, opossum, chipmunk, and muskrat.

Due the presence of existing invasive species, including purple loosestrife and *Phragmites* within the river system, control measures may be necessary to limit the initial establishment of these aggressive species within the newly exposed substrate. It may also be beneficial to provide streambank stabilization through bioengineering measures involving jute matting and *Spartina* planting and seeding (see **Appendix D**, Sediment Management Plan).

3.13 Cultural and Historic Resources

3.13.1 Area of Potential Effect

The Area of Potential Effect (APE) of the I-95 bridge replacement project extends from below the Old Stage Road bridge downstream approximately 2 miles to the point at which the existing river channel joins the Taylor River's original natural channel, east of I-95 (**Figure 38**). This area encompasses the pond upstream of the Dam, I-95, and the land between the highway embankment and the State Liquor Store property located northeast of the project area.

No historical resources have been recorded in the APE for the potential removal of the spillways, to date. However, the APE may be sensitive for prehistoric archaeological resources, based on a 2006 letter from the New Hampshire Division of Historical Resources (NHDHR) to the Rockingham County Conservation District regarding a location approximately 0.5 mile downstream of the Taylor River Pond Dam.

Town and archaeological site files at NHDHR were reviewed and preliminary on-line background research was conducted at the New Hampshire State Library. Information about the Taylor River Pond, Dam and the I-95 bridge over Taylor River was obtained from NHDOT and from NHDES Dam Safety Bureau.

3.13.2 Existing Conditions

No cultural resources have been formally recorded to-date in the APE. A reconnaissance of the area conducted in October 2006 by foot, vehicle and kayak, located only one resource clearly over 50 years of age, that being I-95 (originally built in 1948-50 as the "New Hampshire Toll Road") and its constituent elements at this location: the Taylor River Pond spillways and the I-95 bridge.

The Taylor River Pond Dam and I-95 bridge were built between 1948 and 1950 in association with construction of the "New Hampshire Toll Road". The embankment section provided the stable ground needed to support the 4-lane highway across the floodplain. The location of the Taylor River Pond primary spillway and the I-95 bridge over Taylor River, at the north end of the embankment (rather than further south), represented a substantial realignment of the stream flow (apparently due to the presence here of dense granular soil that would provide better foundation for the bridge abutments, as discussed in Section 3.2).

The existing bridge is 15 feet wide and approximately 8 feet high, with steel pile sides and a concrete top slab. Beyond the bridge, the realigned stream was accommodated by construction of a short canal that directed the discharge from the bridge back south to join the historical river channel downstream from the highway. In the early 1950s, the spillway appears to have been relocated closer to the bridge, utilizing the existing sheet piling. The concrete fishway was added in the late 1960s to facilitate movement of fish upstream. The New Hampshire Toll Road eventually became part of Interstate 95. With the widening of I-95 in the 1970s, the I-95 bridge over the Taylor River was widened accordingly and the downstream wingwalls rebuilt. At the same time, an emergency spillway and culvert was constructed several hundred feet to the south of the primary spillway to accommodate high flows.

Historically undeveloped, the Hampton side of Taylor River Pond, between I-95 and Towle Farm Road, was gradually built up through the middle and late 20th century, the pond attract people who built seasonal camps and, with increasing frequency, year-round residences. The Hampton Falls side of the impoundment has remained less developed, perhaps as a result of the steep slopes on this side of the river.

The Taylor River Pond primary spillway was built in response to a request from the NH Fish and Game Department for a mitigation measure providing waterfowl resting habitat. In the 1940s "creation of artificial freshwater impoundments in coastal wetland areas was a standard practice" on national wildlife refuges, employed at the urging of sportsmen to provide habitat for "targeted species of waterfowl," particularly Black Duck (PRNWR, undated). This practice also appears to have been adopted by state wildlife management agencies, such as New Hampshire's.

In its Section 106 reviews of this project with NHDOT, the last of which took place on December 17, 2007, NHDHR determined that the Taylor River Pond spillways, fishway, and the I-95 bridge were not eligible for the National Register, based on their materials and lack of significant engineering considerations associated with their construction.

3.13.3 Archaeological Potential

NHDHR files indicate that this area of New Hampshire has documented potential to contain prehistoric archaeological resources. Goodby (2003) has noted that the proximity of upland, estuarine and coastal environments (the first two particular are present in the Taylor River Project area), offered opportunities for subsistence with great diversity, thereby, attracting Native peoples throughout most of the pre-contact period.

Evidence of prehistoric occupation of this area has been documented at six prehistoric sites on the lower Hampton Falls River (east of I-95), and two on the lower Taylor River (also east of I-95). Chiefly artifact collectors recorded all of these sites in the 1970s and 1980s, and temporal and functional information about them is limited. However, site 27-RK-0160 on the Hampton Falls River produced artifacts dated to the mid-late Archaic and mid-late Woodland periods; and Site 27-RK-0055, approximately ½ mile further downstream, is described as a fishing station with artifacts (pestle, cobble weight, stemmed projectile point, and hammer stones) dated to the late Archaic period. The presence of these sites, as well as many others identified in similar environments elsewhere in this area of New Hampshire, lend support to NHDHR's observation (regarding Rockingham County's proposed Marsh Lane Conservation Preserve project on the Taylor River within a mile below I-95) that "the area is considered archaeologically sensitive with regard to Native American site potential" (McConaha to Degnan, June 22, 2006; see **Appendix F**). However, NHDHR's review of the I-95 bridge replacement and spillway removal/replacement project concluded that archaeological investigations were not necessary as long as the water level in the impoundment did not change.

3.13.4 Impact Analysis

3.13.4.1 Alternative A

The no-action alternative would maintain existing conditions and would involve no ground disturbance and no changes to the elevation of the pond or to the existing alignment of the Taylor River above or below I-95. In the event of spillway failure, however, lowering of the water level in the pond could potentially expose previously submerged archaeological resources.

3.13.4.2 Alternative B

Alternative B, which would move the location of the I-95 bridge and the primary spillway southerly to the historic river channel, would result in removal of the existing I-95 bridge, the Taylor River Pond primary spillway, fishway, and emergency spillway structures; none of which are eligible for inclusion in the National Register. Because the pond elevation would remain the same, Alternative B would not affect any archaeological resources that may be present.

3.13.4.3 Alternative C

Alternative C would also relocate the bridge over the Taylor River to the historic channel location, with attendant removal of the existing bridge, primary spillway, and emergency spillway structures. It would also result in draining of the pond, substantial exposure of now-submerged land, and potential effects to archaeological resources from construction activities in undisturbed soils.

Because this alternative would change the water level of the pond, consultation with the NHDHR would be required regarding the need for investigations to locate and identify archaeological resources in the APE. Should National Register-eligible archaeological resources be identified as a result of such investigations, further consultation would be required to determine effects and measures to mitigate any adverse effects on these resources.

4.0 SUMMARY

The purpose of this Feasibility Study was to evaluate various alternatives for replacing the I-95 bridge, spillways and fishway; as an effort to address transportation, public safety, flood management, water quality, and fish passage issues for the Taylor River and impoundment. Twelve conceptual alternatives were evaluated. Nine of these alternatives were determined to not be feasible. The remaining three "primary alternatives" are as follows:

- **Alternative A - No Action:** This alternative would be the continuation of the status quo, with maintenance of the I-95 bridge, primary spillway/fishway, and the emergency spillway/culvert in their current condition. This is the least desirable alternative, as it would not achieve the goals of the project relative to fisheries, flooding, dam safety, and the I-95 bridge. The existing structures are deteriorating, and require repair and/or replacement. The structures are at risk of failure which would adversely affect the natural resources of the area, and possibly place the downstream highway and travelers at risk.

- **Alternative B - Replacement of I-95 Bridge and a New Spillway and Fishway:** This alternative includes the replacement of the existing I-95 bridge with new 70-foot-wide concrete and steel bridge over the Taylor River at a location south of the current bridge, and replacement of the existing spillways with a new 50-foot-wide spillway and a new Denil fishway. The new spillway would provide additional spillway capacity during high-flow conditions which would reduce flood levels in the pond. The new I-95 bridge would replace the existing deteriorating bridge over the Taylor River. A new Denil fishway would improve fish passage into the Taylor River Pond for river herring, allowing the pond and its tributary habitat to be more fully utilized by river herring.

- **Alternative C – I-95 Bridge Replacement with No Spillway:** This alternative would replace the I-95 bridge with a new 70-foot-wide bridge, similar to Alternative B, and remove the existing Taylor River Pond spillways, culverts and fishway. The bridge would be sized to accommodate a 100-year storm event with no freeboard to the low chord of the bridge. This alternative would allow the migration of diadromous and other fish species into the former impoundment area and possibly further upstream without fishway, and would fully alleviate the flooding problem for abutting properties around Taylor River Pond. The existing freshwater pond would be eliminated; instead, the original tidal channel in the existing impoundment area would be restored.

The beneficial and adverse effects of implementing the three primary alternatives on existing baseline conditions for all resource areas studied are summarized below in Table 20 below.

As can be seen in this table, the benefits and adverse effects of the project on the resources studied vary dependent upon the conditions proposed. The various issues discussed in this Feasibility Study, including the estimated costs (discussed in Section 5 below) must be taken into account in the NHDOT's decision-making process for this project.

Table 20 – Summary of Impacts

Resources	Alternative A No Action		Alternative B Replace Bridge & Spillway		Alternative C New Bridge with No Spillway	
	Adverse Impacts	Beneficial Impacts	Adverse Impacts	Beneficial Impacts	Adverse Impacts	Beneficial Impacts
Flooding	Major	None	Negligible	Moderate	None	Major
Sediment Transport *(1)*	Moderate	None	Minor	None	Moderate	None
Water Wells *(2)*	None	None	None	None	None	None
Dry Fire Hydrants	None	Moderate	None	Moderate	Major	None
Socio-Economic	Moderate	Negligible	Moderate	Minor	Moderate	Moderate
Recreational Use	None	None	Minor	Minor	Moderate	Moderate
Cultural & Historical	None	None	Minor	None	Moderate	None
Water Quality	Moderate *(3)*	None	None	None	Moderate *(4)*	Major *(5)*
Fisheries	Moderate	None	Moderate	Minor	Major	Major
Species of Concern	None	None	None	Minor	Negligible	Moderate
Wetlands	Minor	None	Negligible	None	Moderate	Major

Levels of Impacts:

None: No impact.

Negligible: Impacts would be barely detectable, measurable, or observable.

Minor: Impacts would be detectable, but not expected to have an overall effect on the resource.

Moderate: Impacts would be clearly detectable and could have short-term or long-term,, appreciable effects on the resource.

Major: Long-term or permanent, highly noticeable effects on the resource.

Notes:

(1) Assumes mitigation measures were implemented.
(2) Additional studies required.
(3) There are no impacts, unless a catastrophic failure of the spillway(s) occurs, in which case some of the accumulated sediment in the pond will be washed into the downstream estuary.
(4) Potential water quality impact downstream of estuary from resuspended sediment.
(5) Current low dissolved oxygen conditions will be eliminated but eliminating the pond.

5.0 CONCEPTUAL CONSTRUCTION COST ESTIMATES

A summary of the conceptual costs associated with the alternatives is included in **Table 21, below** for comparison. Based on the impact analysis, Alternatives B and C provide the most environmental and socio-economic benefits.

According to information provided by the NHFGD, the existing fishway annual operation and maintenance costs are estimated as follows:

Personnel Cost:	$10,900
Equipment:	$1,100
Repairs:	$1,500
Dam Registration Fee:	$1500
Total:	**$15,000**

These costs would be maintained for either an existing or proposed fishway, although initially a new fishway may have lower maintenance costs because the structure would be in good condition and not immediately require repairs.

The cost table includes estimated costs for sediment management. A more detailed breakdown of these costs is provided in the Sediment Management Plan (**Appendix D)**.

Table 21 – Conceptual Construction Cost Estimates

Alternative	**Conceptual Construction Cost Estimate**	
Alternative B: Replacement of I-95 Bridge, and a New Spillway and Fishway	Spillway/Culvert Removal	$385,000
	New Spillway	$1,417,000
	New Bridge	$4,840,000
	Sediment Removal and Disposal *	$200,000
	Roadway and Traffic Control	$1,900,000
	Total =	**$8,742,000**
Alternative C: Replacement of I-95 Bridge without Spillway	Spillway/Culvert Removal	$385,000
	New Bridge	$2,251,000
	Sediment Removal and Disposal *	$685,000
	Fire Cisterns	$750,000
	Roadway and Traffic Control	$1,900,000
	Total =	**$8,560,000**

This estimate does not include annual operations and maintenance costs for the new spillway and/or new bridge.

* This cost estimate assumes that the excavated sediment can be disposed of at an upland site adjacent to the Dam. Alternatively, landfill disposal is estimated to *add* the following costs to the listed costs for sediment removal and disposal:

- between $74,000 and $152,000 under Alternative B
- between $460,000 and $915,000 under Alternative C.

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TABLES

Table 1 – Existing Taylor River Pond Dam HydroCAD® Analysis Summary				
	Alternative A – No Action Existing (15.2 ft. Primary Spillway width), EL = 8.55 ft.			
Storm Events (Year)	2	10	50	100
Flow (cfs)	246.7	769.1	1,508	1,981
Water Surface EL @ Dam (ft.)	10.06	11.93	14.17	15.72

Table 2 - Taylor River Pond Dam
HEC-RAS Analysis Summary

Alternative B: New 70-Foot Bridge WITH Spillway
With High Monthly Tide (EL = 7.21') Blocked up to Spillway

River Station	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Top Width
697	2 year	246.7	7.21	9.07	2.06	68.5
697	10 year	769.07	7.21	10.29	3.68	113.86
697	50 year	1508.5	7.21	11.56	4.54	176.58
697	100 year	1981.2	7.21	12.68	4.19	231.83
Proposed I-95 Bridge						
458	2 year	246.7	7.21	8.73	2.5	236.27
458	10 year	769.07	7.21	9.46	2.44	387.12
458	50 year	1508.5	7.21	10	3.03	452.8
458	100 year	1981.2	7.21	10.22	3.45	504.73

Table 3 – Taylor River Pond Dam
HEC-RAS Analysis Summary

Alternative C: New 70-Foot Bridge WITHOUT Spillway
With High Monthly Tide (EL = 7.21') Blocked Entire Reach

River Station	Storm Event	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Vel Chnl (ft/s)	Top Width
697	2 year	246.7	7.21	9.09	2.05	120.58
697	10 year	769.07	7.21	10.29	3.7	223.65
697	50 year	1508.5	7.21	11.54	4.68	405.39
697	100 year	1981.2	7.21	12.64	4.43	627.52
Proposed I-95 Bridge						
458	2 year	246.7	7.21	8.76	2.44	100.99
458	10 year	769.07	7.21	9.48	2.4	397.51
458	50 year	1508.5	7.21	9.97	3.11	603.03
458	100 year	1981.2	7.21	10.25	3.37	739.86

Table 4 – Taylor River Pond Dam
HEC-RAS Analysis Summary

With High Monthly Tide (EL = 7.21') Blocked

	Alternative B: New 70-Foot Bridge WITH 50-Foot Spillway (1)				**Alternative C: New 70-Foot Bridge WITHOUT Spillway(2)**			
Stations / Storm Events (Year)	2	10	50	100	2	10	50	100
Station 14+48 (Chamberlain) Sill EL = 14.25 ft.	9.96	11.57	13.28	14.22	9.21	10.62	12.01	13.03
Station 9+73	9.96	11.56	13.27	14.22	9.18	10.58	11.96	12.99
Station 7+51 *DAM*	9.46	10.49	11.60	12.20	9.18	10.56	11.95	12.97
Station 7+22 *(between dam & bridge)*	9.09	10.32	11.58	12.67	N/A	N/A	N/A	N/A
Station 6+97 (just upstream of I-95)	9.07	10.29	11.56	12.68	9.09	10.29	11.54	12.64
Station 4+58 (just downstream of I-95)	8.73	9.46	10.00	10.22	8.76	9.48	9.97	10.25

EL = elevation
(1) Tide blocked up to new spillway.
(2) Tide blocked entire reach.

Table 5 – Taylor River Pond Dam Impoundment
Sediment Quality - Station Locations (Upstream to Downstream)

Station Name	Sample No.	Subsample	Water Depth	Depth of Refusal (from sediment surface)	Analyses: Grain Size	Metals	Pesticides	PCBs	VOCs	SVOCs	TOC	Toxicity	Comments
			(feet)	(feet)									
Sampling Event 1 (November 30, 2006)													
Taylor River, between Rice Dam and upstream of Taylor River Impoundment	TR-S1	Three subsamples from edge of sediment islands within the Taylor River			●	●	●	●	●	●	●		*(1)*
Mid section of Taylor River Impoundment	TR-S2	East (1 of 3)	4.0	0.5									
		Center (2 of 3)	4.0	0.7	●	●	●	●	●	●	●		
		West (3 of 3)	6.0	1.9									
Lower Taylor River Impoundment	TR-S5	Central (1 of 2)	4.5	2.0	●	●	●	●	●	●	●		
		South (2 of 2)	6.5	1.5									
Downstream of Taylor River Dam	TR-S4	Three subsamples were collected from the intertidal zone, approximately 50 m apart.			●	●	●	●	●	●	●		
Sampling Event 2 (April 6, 2007)													
Rice Impoundment	TR-S11	Center (1 of 2)	4.6	0.3									
		Lower (2 of 2)	6.0	0.7	●	●	●	●			●	●	
		Lower (2 of 3)	--	--									
Upper Taylor River Impoundment	TR-S8	2 subsamples 30 feet apart	3.0	1.3	●								
Mid section of Taylor River Impoundment	TR-S7	East (1 of 3)	4.0	1.0									
		Center (2 of 3)	5.0	3.0	●	●	●	●			●	●	
		West (3 of 3)	3.6	1.0									
Downstream of TR-S7	TR-S9	2 subsamples 30 feet apart	4.3	0.8	●								
Downstream of TR-S9	RE-S10	2 subsamples 30 feet apart	4.3	0.7	●								
Lower Taylor River Impoundment	TR-S6	South (1 of 3)	3.6	n/a									
		Central (2 of 3)	4.0	1.0	●	●	●	●			●	●	
		North (3 of 3)	4.3	1.6									

(1) The river was flowing freely in this section. The grain size at this station was coarser than in the impoundments.

Analytical Methods

Parameter	*Method*	
VOCs	8260B	
SVOCs	8270C	
PAHs	8270c-SIM	
Pesticides	8081A	
PCB Aroclors	8082	
TOC	9060	
Metals	6020/7471	Arsenic, barium, cadmium, chromium, copper, lead, nickel, zinc, mercury

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Table 6 – Taylor River Pond Dam Impoundment
Sediment Quality - Grain Size

Sample No.	Sampling Date	Location *(Upstream to downstream)*	Sieve Size		Grain Size (% of total sample) – Sieve Analysis – Gravel				Coarse Sand	Medium Sand	Fine Sand	Hydrometer – Silt	Hydrometer – Clay	Grain Size (% of total sample) - Sum - Total Gravel	Total Sand	Silt and Clay
			Mesh	from	2"	1"	3/4"	3/8"	#4	#10	#40					
				to	1"	3/4"	3/8"	#4	#10	#40	#200					
			inch	from	1.50	1.00	0.75	0.375								
				to	1.00	0.75	0.50	0.187								
			mm	from	50.8	25.4	19.1	9.5	4.75	2.00	0.420	0.074	<0.005			
				to	25.4	19.1	12.7	4.75	2.00	0.42	0.074	0.005				
TR-S11	9-Apr-07	Rice Impoundment	%						0.3	39.5	5.9	46.1	8.2		45.7	54.3
TR-S1	30-Oct-06	Taylor River, between Rice Dam and upstream of Taylor River Impoundment	%				6.7	12.2	8.2	28.4	21.9	14.1	8.5	19.0	58.5	22.6
Taylor River Impoundment																
TR-S8	9-Apr-07	Upper impoundment (upstream of Towle Farm Road)	%							37.6	7.4	48.8	6.2		45.0	55.0
TR-S7	9-Apr-07	Mid section of Taylor River Impoundment (downstream of Towle Farm Road)	%							40.4	10.6	40.4	8.6		51.0	49.0
TR-S2	30-Oct-06		%							61.0	18.0	15.4	5.6		79.0	21.0
TR-S9	9-Apr-07	Downstream of TR-S2/S7	%							43.6	13.6	28.7	14.1		57.2	42.8
TR-S10	9-Apr-07	Downstream of TR-S9	%							35.8	19.0	39.9	5.3		54.8	45.2
TR-S6	9-Apr-07	Lower Impoundment, near Taylor River Dam	%							36.2	18.6	35.6	9.6		54.8	45.2
TR-S5	30-Oct-06		%					1.6	19.5	22.9	18.1	31.7	6.2	1.6	60.5	37.9
Mean - Taylor River Impoundment			%					**0.2**	**2.8**	**39.6**	**15.0**	**34.4**	**7.9**	**0.2**	**57.5**	**42.3**
TR-S4	30-Oct-06	Downstream of Taylor River Impoundment	%				0.7	2.0	11.5	17.2	45.5	17.1	6.1	2.7	74.1	23.2

Note: Samples collected on April 9, 2007 were considerably larger (1 gallon) and thus are more representative than samples from November 30, 2006 (500 ml).
The sample size was increased for the second sampling event due to the high water content of the bottom sediments, particularly from within the Taylor River impoundment.

Table 7 – Taylor River Pond Dam Impoundment Sediment Accumulation - Measured on December 18, 2006							
Station ID	Latitude (WGS 84)	Longitude (WGS 84)	Northing (NH SP- 1983)	Easting (NH SP- 1983)	Water Depth	Refusal Depth (from water surface)	Sediment Thickness *(1)*
			feet	feet	feet	feet	feet
1	N 42 56.0731	W 70 51.9262	159392.81	1198817.64	3.7	*ed*	
2	N 42 56.0965	W 70 51.9194	159535.24	1198846.64	3.3	*ed*	
3	N 42 56.1082	W 70 51.9313	159605.81	1198792.85	3.3	*ed*	
4	N 42 56.1361	W 70 51.9192	159775.80	1198845.24	3.0	3.8	0.8
5	N 42 56.1134	W 70 51.9263	159637.61	1198814.86	3.1	4.0	0.9
6	N 42 56.0941	W 70 51.9334	159520.07	1198784.29	3.6	4.2	0.6
7	N 42 56.0761	W 70 51.9182	159411.38	1198853.17	4.0	4.8	0.8
8	N 42 56.9532	W 70 51.9141	164739.40	1198820.70	3.8	4.6	0.8
9	N 42 56.0311	W 70 51.9014	159138.74	1198930.76	3.9	4.4	0.5
10	N 42 56.0174	W 70 51.8642	159057.11	1199097.59	3.6	4.5	0.9
11	N 42 56.0141	W 70 51.8335	159038.37	1199234.81	3.3	5.1	1.8
12	N 42 55.9951	W 70 51.8459	158922.43	1199180.56	3.5	5.8	2.3
13	N 42 55.9760	W 70 51.8554	158806.00	1199139.27	3.3	5.0	1.7
14	N 42 55.9642	W 70 51.8651	158733.91	1199096.66	4.2	5.0	0.8
15	N 42 55.9753	W 70 51.9021	158799.76	1198930.87	10.3	12.5	2.3
16	N 42 55.9940	W 70 51.8883	158913.94	1198991.38	3.8	5.0	1.2
17	N 42 56.0030	W 70 51.8779	158969.05	1199037.28	3.3	4.3	1.0
18	N 42 56.0014	W 70 51.9203	158957.53	1198848.12	3.3	4.7	1.3
19	N 42 55.9932	W 70 51.9421	158906.79	1198751.29	5.0	5.8	0.8
20	N 42 55.9783	W 70 51.9581	158815.60	1198680.74	4.1	6.0	1.9
21	N 42 55.9881	W 70 51.9874	158873.89	1198549.40	3.6	4.3	0.8
22	N 42 56.0059	W 70 51.9862	158982.06	1198553.72	3.3	4.2	0.8
23	N 42 56.0189	W 70 51.9800	159061.29	1198580.65	3.3	4.1	0.8
24	N 42 56.0449	W 70 52.0331	159216.97	1198342.14	3.7	4.3	0.7
25	N 42 56.0351	W 70 52.0545	159156.54	1198247.19	4.0	4.8	0.8
26	N 42 56.0672	W 70 52.0674	159350.98	1198187.76	3.3	3.8	0.6
27	N 42 56.0619	W 70 52.0848	159318.05	1198110.40	8.3	10.3	2.0
28	N 42 56.0932	W 70 52.0841	159508.20	1198111.72	3.7	4.2	0.5
29	N 42 56.0850	W 70 52.1142	159457.12	1197977.85	3.3	3.9	0.7
30	N 42 56.1199	W 70 52.1301	159668.44	1197904.87	3.4	4.0	0.6
31	N 42 56.1540	W 70 52.1365	159875.31	1197874.34	5.3	7.8	2.6
32	N 42 56.1723	W 70 52.1534	159985.75	1197797.86	8.9	9.4	0.5
33	N 42 56.1999	W 70 52.1740	160152.54	1197704.33	3.3	4.1	0.8
34	N 42 56.2140	W 70 52.2175	160236.35	1197509.37	3.3	4.2	0.8
35	N 42 56.2001	W 70 52.2313	160151.33	1197448.58	3.0	3.9	0.9
36	N 42 56.1888	W 70 52.2381	160082.40	1197418.88	6.8	7.4	0.6
37	N 42 56.1740	W 70 52.2137	159993.53	1197528.63	4.0	4.8	0.8
38	N 42 56.1583	W 70 52.1912	159899.11	1197629.96	3.0	3.7	0.7
39	N 42 56.1899	W 70 52.2758	160087.49	1197250.55	3.8	4.5	0.8

Table 7 – Taylor River Pond Dam Impoundment
Sediment Accumulation - Measured on December 18, 2006

Station ID	Latitude (WGS 84)	Longitude (WGS 84)	Northing (NH SP- 1983)	Easting (NH SP- 1983)	Water Depth	Refusal Depth (from water surface)	Sediment Thickness *(1)*
			feet	feet	feet	feet	feet
40	N 42 56.1931	W 70 52.2740	160107.00	1197258.40	3.7	4.4	0.8
41	N 42 56.1994	W 70 52.2770	160145.15	1197244.65	3.2	3.8	0.6
42	N 42 56.2065	W 70 52.2771	160188.27	1197243.80	4.0	5.0	1.0
43	N 42 56.1899	W 70 52.3027	160086.36	1197130.49	5.0	5.4	0.4
44	N 42 56.1800	W 70 52.3379	160024.73	1196973.96	6.5	6.8	0.3
45	N 42 56.1869	W 70 52.3360	160066.73	1196982.04	3.0	3.7	0.7
46	N 42 56.1939	W 70 52.3376	160109.18	1196974.50	2.8	3.7	0.8
47	N 42 56.2038	W 70 52.3870	160167.24	1196753.45	3.0	3.7	0.7
48	N 42 56.1896	W 70 52.3932	160080.72	1196726.59	2.3	3.6	1.3
49	N 42 56.1765	W 70 52.3961	160001.02	1196714.40	7.8	8.2	0.3
50	N 42 56.1768	W 70 52.4190	160001.88	1196612.18	9.0	9.1	0.1
51	N 42 56.1990	W 70 52.4613	160134.95	1196422.11	6.0	6.2	0.2
52	N 42 56.2509	W 70 52.4621	160450.18	1196415.57	2.9	4.0	1.1
53	N 42 56.2488	W 70 52.4794	160436.70	1196338.48	2.7	4.9	2.3
54	N 42 56.2454	W 70 52.4721	160416.35	1196371.26	2.7	3.9	1.3
55	N 42 56.2482	W 70 52.4668	160433.58	1196394.75	2.6	3.5	0.9
56	N 42 56.2721	W 70 52.4831	160578.07	1196320.64	2.5	3.4	0.9
57	N 42 56.2883	W 70 52.4886	160676.25	1196295.16	2.1	2.9	0.8
58	N 42 56.2824	W 70 52.5008	160639.90	1196241.05	2.9	3.6	0.7
59	N 42 56.3012	W 70 52.5113	160753.65	1196193.11	2.0	2.5	0.5
60	N 42 56.3240	W 70 52.5168	160891.92	1196167.26	2.0	3.7	1.7
61	N 42 56.3285	W 70 52.5086	160919.60	1196203.60	2.7	3.7	1.0
62	N 42 56.3362	W 70 52.5230	160965.77	1196138.89	1.5	2.9	1.4
63	N 42 56.3634	W 70 52.5272	161130.81	1196118.60	6.3	7.3	1.0
64	N 42 56.3599	W 70 52.5526	161108.49	1196005.44	3.5	4.9	1.4
65	N 42 56.3823	W 70 52.5460	161244.83	1196033.61	1.0	2.0	1.0
66	N 42 56.3810	W 70 52.5383	161237.26	1196068.05	1.8	3.2	1.3
67	N 42 56.4115	W 70 52.5600	161421.61	1195969.46	2.0	3.5	1.5
68	N 42 56.4253	W 70 52.5790	161504.64	1195883.88	3.0	5.8	2.8
69	N 42 56.4296	W 70 52.5902	161530.29	1195833.65	3.0	5.2	2.2
70	N 42 56.4456	W 70 52.6020	161626.99	1195780.08	2.3	2.8	0.4
71	N 42 56.4576	W 70 52.6124	161699.45	1195732.98	3.7	4.3	0.7
72	N 42 56.4723	W 70 52.6151	161788.63	1195720.09	1.7	2.3	0.7
Mean							**1.0**
Median							**0.8**
Minimum							**0.1**
Maximum							**2.8**

(1) Refusal depth minus Water depth.
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Table 8 – Taylor River Pond Dam Impoundment
Sediment Quality - All Compounds (Except VOCs)

SAMPLE ID (1)	Sediment Concentrations in Taylor River Impoundment														Freshwater Criteria (1)						Marine Water Criteria						
	TR-S1		TR-S5		TR-S2		TR-S4		TR-S6		TR-S7		TR-S11		McDonald (2)		1999 NOAA SQUIRTs, 1999 (3)				1999 NOAA SQUIRTs, 1999 (3)					Barrick, 1988 (7)	
	Downstream of Impoundm.		Lower Impoundm.		Mid-Impoundm.		Upstream of Impoundm.		Lower Impoundm.		Mid-Impoundm.		Rice Impoundm.		TEC Consensus Effect Concentr.	PEC Probable Effect Concentr.	TEL Lowest ARCs *H.azteca*	TEL Threshold Effects Level	PEL Probable Effects Level	UET Upper Effects Threshold	TEL Threshold Effects Level	ERL Effects Range-Low	PEL Probable Effects Level	ERM Effect Range-Median	AET Apparent Effects Threshold (4)	AET-L Apparent Effects Threshold - Low (4)	AET-H Apparent Effects Threshold - High (4)
	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual													
Metals (mg/kg)																											
Arsenic	12		36		17		24		28		26		21		9.79	33	10.8	5.9	17	17 M	7.24	8.2	41.6	70	35 B	57 X	
Barium (6)	36		130		83		42		120		120		87		20										48 A		
Cadmium	0.16		1.2		0.53		0.19		0.87		0.97		0.55		0.99	4.98	0.58	0.60	3.53	3 I	0.68	1.2	4.21	9.6	3 N	5.1 X	9.6 O
Chromium	40		44		28		34		37		38		36		43.4	111	36.3	37.3	90	95 H	52.3	81	160	370	62 N	260 X	270 A
Copper	14		35		18		15		28		28		19		31.6	149	28.0	35.7	197	86 I	18.7	34	108	270	390 MO	390 O	1,300 A
Lead	25		87		32		8.8		60		56		33		35.8	128	37	35	91.3	127 H	30.2	46.7	112	218	400 B	450 X	660 AO
Mercury	0.017		0.21		0.095		0.039		0.26		0.21		0.12		0.18	1.06		0.17	0.49	0.56 M	0.13	0.15	0.70	0.71	0.41 MO	0.59 O	2.1 AX
Nickel	28		38		21		25		31		31		29		22.7	48.6	19.5	18	35.9	43 H	15.9	20.9	42.8	51.6	110 EL		
Zinc	66		240		110		56		180		180		130		121	459	98	123.1	315	520 M	124	150	271	410	410 I	410 X	1,600 O
Pesticides by 8081 (ug/kg) (Range of Method Detection Limits for these compounds: **0.011 - 0.130 ug/kg**)																											
4,4'-DDD	1.5	U	24		6.8		2.7	U	12		5.1		2.5		4.88	28		3.54	8.51	60 I	1.22	2	7.81	20	16 I	16 X	43 A
4,4'-DDE	7.5		61		16	I	2.7	U	22		19	I	6.1		3.16	31.3		1.42	6.75	50 I	2.07	2.2	374	27	9 I	9 X	15 A
4,4'-DDT	4.1		16		8.7	P	2.7	U	2.2		1.5	I	1.8	I	4.16	62.9				<50 I	1.19	1	4.77	7	12 E	34 X	34 X
Aldrin	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U						40 I					9.5 AE		
alpha-BHC	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U													
alpha-Chlordane	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U	3.24	17.6		4.5	8.9	30 I	2.26	0.5	4.79	6	2.8 A		
beta-BHC	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U													
delta-BHC	2.4		9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U													
Dieldrin	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U	1.9	61.8		2.85	6.67	300 I	0.715	0.02	4.3	8	1.9 E		
Endosulfan I	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U													
Endosulfan II	3.0		9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U													
Endosulfan sulfate	7.8		20		20	P	5.7		0.59	U	0.78		1.1														
Endrin	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U	2.22	207		2.67	62.4	500 I							
Endrin aldehyde	5.7		22		10		4.0		0.59	U	0.50	U	0.40	U													
Endrin ketone	4.2		14		9.5		2.7	U	0.59	U	1.20		0.40	U													
gamma-BHC (Lindane)	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U	2.37	4.99		0.94	1.38	9 I	0.32		0.99		>4.8 N		
gamma-Chlordane	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.98		0.40	U													
Heptachlor	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U						10 I					0.3 B		
Heptachlor epoxide (B)	1.5	U	9.3	U	4.7	U	2.7	U	0.59	U	0.50	U	0.40	U	2.47	16		0.6	2.74	30 I							
Methoxychlor	12	BP	96	BP	26	BP	14	B	5.5	P	7.1		3.7														
Toxaphene	75	U	470	U	240	U	140	U	30	U	25	U	20	U													
Polychlorinated Biphenyls by 8082 (ug/kg) (Range of Method Detection Limits for these compounds: **1.01 - 1.43 ug/kg**)																											
Aroclor 1016	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1221	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1232	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1242	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1248	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1254	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Aroclor 1260	60	U	370	U	190	U	110	U	24	U	20	U	16	U							21.6	22.7	189	180		1,000 X	3,100 A
Total PCBs	<60	U	<370	U	<190	U	<110	U	<24	U	<20	U	<16	U	59.8	676	31.6	34.1	277	26 M	21.6	22.7	189	180	130 M	1,000 X	3,100 A
Semi-Volatile Organics by 8270 (ug/kg) (Range of Method Detection Limits for these compounds: **6.27 - 15.14 ug/kg**)																											
bis(2-Chloroethyl)ether	310	U	1,900	U	920	U	580	U																			
Phenol	310	U	1,900	U	920	U	580	U												48 H					130 E	420 X	1,200 AX
2-Chlorophenol	310	U	1,900	U	920	U	580	U																	8 A		
1,3-Dichlorobenzene	310	U	1,900	U	920	U	580	U																			
1,4-Dichlorobenzene	310	U	1,900	U	920	U	580	U																	110 IM	110 X	120 AO
1,2-Dichlorobenzene	310	U	1,900	U	920	U	580	U																			

Table 8 – Taylor River Pond Dam Impoundment
Sediment Quality - All Compounds (Except VOCs)

SAMPLE ID *(1)*	Sediment Concentrations in Taylor River Impoundment														Freshwater Criteria *(1)*						Marine Water Criteria						
	TR-S1		TR-S5		TR-S2		TR-S4		TR-S6		TR-S7		TR-S11		McDonald *(2)*		1999 NOAA SQUIRTs, 1999 *(3)*				1999 NOAA SQUIRTs, 1999 *(3)*					Barrick, 1988 *(7)*	
	Downstream of Impoundm.		Lower Impoundm.		Mid-Impoundm.		Upstream of Impoundm.		Lower Impoundm.		Mid-Impoundm.		Rice Impoundm.		TEC	PEC	TEL	TEL	PEL	UET	TEL	ERL	PEL	ERM	AET	AET-L	AET-H
	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Consensus Effect Concentr.	Probable Effect Concentr.	Lowest ARCs *H.azteca*	Threshold Effects Level	Probable Effects Level	Upper Effects Threshold	Threshold Effects Level	Effects Range-Low	Probable Effects Level	Effect Range-Median	Apparent Effects Threshold *(4)*	Apparent Effects Threshold - Low *(4)*	Apparent Effects Threshold - High *(4)*
Benzyl alcohol	310	U	1,900	U	920	U	580	U																	52 B	73 X	870 AX
bis(2-chloroisopropyl)ether	310	U	1,900	U	920	U	580	U																			
2-Methylphenol	310	U	1,900	U	920	U	580	U																	8 B		
Hexachloroethane	310	U	1,900	U	920	U	580	U																	73 BL		
n-Nitroso-di-n-propylamine	310	U	1,900	U	920	U	580	U																			
4-Methylphenol	310	U	1,900	U	920	U	580	U																	100 B		
Nitrobenzene	310	U	1,900	U	920	U	580	U																	21 N		
Isophorone	310	U	1,900	U	920	U	580	U																			
2-Nitrophenol	310	U	1,900	U	920	U	580	U																			
2,4-Dimethylphenol	310	U	1,900	U	920	U	580	U																	18 N	29 O	210 X
Benzoic acid *(5)*	1,200	U	**25,000**		**3,000**	J	2,300	U																	65 O	650 OX	760 A
bis(2-Chloroethoxy)methane	310	U	1,900	U	920	U	580	U																			
2,4-Dichlorophenol	310	U	1,900	U	920	U	580	U																	5 A		
1,2,4-Trichlorobenzene	310	U	1,900	U	920	U	580	U																			
Naphthalene	310	U	1,900	U	920	U	580	U																			
4-Chloroaniline	310	U	1,900	U	920	U	580	U																			
Hexachlorobutadiene	310	U	1,900	U	920	U	580	U																			
4-Chloro-3-methylphenol	310	U	1,900	U	920	U	580	U																			
2-Methylnaphthalene	310	U	1,900	U	920	U	580	U																		670 O	1,900 A
Hexachlorocyclopentadiene	310	U	1,900	U	920	U	580	U																			
2,4,6-Trichlorophenol	310	U	1,900	U	920	U	580	U																	6 I		
2,4,5-Trichlorophenol	310	U	1,900	U	920	U	580	U																	3 I		
2-Chloronaphthalene	310	U	1,900	U	920	U	580	U																			
2-Nitroaniline	310	U	1,900	U	920	U	580	U																			
Dimethylphthalate	310	U	1,900	U	920	U	580	U																	6 B	160 X	160 X
2,6-Dinitrotoluene	310	U	1,900	U	920	U	580	U																			
3-Nitroaniline	310	U	1,900	U	920	U	580	U																			
2,4-Dinitrophenol	1,200	U	7,700	U	3,700	U	2,300	U																			
Dibenzofuran	310	U	1,900	U	920	U	580	U												5,100 H					110 E	540 O	1,700 A
2,4-Dinitrotoluene	310	U	1,900	U	920	U	580	U																			
4-Nitrophenol	310	U	1,900	U	920	U	580	U																			
4-Chlorophenyl-phenylether	310	U	1,900	U	920	U	580	U																			
Diethylphthalate	310	U	1,900	U	920	U	580	U																	6 BL	200 X	200 X
4-Nitroaniline	310	U	1,900	U	920	U	580	U																			
4,6-Dinitro-2-methylphenol	1,200	U	7,700	U	3,700	U	2,300	U																			
n-Nitrosodiphenylamine	310	U	1,900	U	920	U	580	U																	28 I	28 X	130 O
4-Bromophenyl-phenylether	310	U	1,900	U	920	U	580	U																			
Hexachlorobenzene	310	U	1,900	U	920	U	580	U												100 I					6 B	22 X	230 O
Pentachlorophenol	310	U	1,900	U	920	U	580	U																	17 B	360 A	690 X
Carbazole	310	U	1,900	U	920	U	580	U																			
Di-n-butylphthalate	310	U	1,900	U	920	U	580	U												110 H					58 BL	1,400 AO	1,400 AO
Butylbenzylphthalate	310	U	1,900	U	920	U	580	U																	63 M M	900 AX	900 AX
3,3'-Dichlorobenzidine	310	U	1,900	U	920	U	580	U																			
bis(2-Ethylhexyl)phthalate	310	U	1,900	U	920	U	580	U																		1.300 X	1,900 O
Di-n-octylphthalate	310	U	1,900	U	920	U	580	U																	63 BL	6,200 X	6,200 X
Acenaphthylene	310	U	1,900	U	920	U	580	U																			
Acenaphthene	310	U	1,900	U	920	U	580	U																			
Fluorene	310	U	1,900	U	920	U	580	U																			
Phenanthrene	310	U	1,900	U	**500**	J	580	U																			
Anthracene	310	U	1,900	U	920	U	580	U																			
Fluoranthene	310	U	1,900	U	**770**	J	580	U																			
Pyrene	310	U	1,900	U	**700**	J	580	U																			
Benz[a]anthracene	310	U	1,900	U	920	U	580	U																			

(also analyzed with the more sensitive Method 8270 - see below)

Table 8 – Taylor River [illegible]d Dam Impoundment
Sediment Quality - All Compounds (Except VOCs)

SAMPLE ID (1)	TR-S1 Downstream of Impoundm. Conc.	Qual	TR-S5 Lower Impoundm. Conc.	Qual	TR-S2 Mid-Impoundm. Conc.	Qual	TR-S4 Upstream of Impoundm. Conc.	Qual	TR-S6 Lower Impoundm. Conc.	Qual	TR-S7 Mid-Impoundm. Conc.	Qual	TR-S11 Rice Impoundm. Conc.	Qual
	Sediment Concentrations in Taylor River Impoundment													
Chrysene	310	U	1,900	U	920	U	580	U						
Benzo[b]fluoranthene	310	U	1,900	U	500	J	580	U						
Benzo[k]fluoranthene	310	U	1,900	U	920	U	580	U						
Benzo[a]pyrene	310	U	1,900	U	920	U	580	U						
Indeno[1,2,3-cd]pyrene	310	U	1,900	U	920	U	580	U						
Dibenz[a,h]anthracene	310	U	1,900	U	920	U	580	U						
Benzo[g,h,i]perylene	310	U	1,900	U	920	U	580	U						
Semi-Volatile Organics by 8270 - SIM (ug/kg) (Range of Method Detection Limits for these compounds: **0.75 - 3.98 ug/kg**)														
Naphthalene	6.2	U	**20**	J	**19**		12.0	U	**14**	J	**20**		**5.3**	J
2-Methylnaphthalene	6.2	U	39	U	**14**	J	12.0	U	**10**	J	**16**		10	U
Acenaphthylene	**7.0**		**77**		**140**		12.0	U	**38**		**110**		**18**	
Acenaphthene	6.2	U	39	U	**14**	J	12.0	U	16	U	**17**		10	U
Fluorene	6.2	U	39	U	**25**		12.0	U	**18**		**38**		**8.5**	J
Phenanthrene	**12**		**110**		**360**		12.0	U	**150**		**430**		**58**	
Anthracene	**3.9**	J	**54**		**110**		12.0	U	**130**		**150**		**10**	
Fluoranthene	**30**		**310**		**720**		**6.2**	J	**240**		**640**		**160**	
Pyrene	**29**		**300**		**690**		12.0	U	**220**		**590**		**140**	
Benz[a]anthracene	**18**		**90**		**220**		12.0	U	**64**		**200**		**74**	
Chrysene	**32**		**160**		**330**		12.0	U	**120**		**320**		**100**	
Benzo[b]fluoranthene	**39**		**160**		**250**		12.0	U	**120**		**260**		**120**	
Benzo[k]fluoranthene	**30**		**130**		**250**		12.0	U	**74**		**200**		**70**	
Benzo[a]pyrene	**18**		**130**		**260**		12.0	U	**67**		**210**		**76**	
Indeno[1,2,3-cd]pyrene	**32**		**140**		**220**		12.0	U	**59**		**170**		**80**	
Dibenz[a,h]anthracene	**23**		**30**	J	**52**		12.0	U	**11**	J	**38**		**15**	
Benzo[g,h,i]perylene	**35**		**140**		**210**		12.0	U	**64**		**170**		**75**	
Total PAH	**321**		**1,910**		**3,884**		<12		**1,407**		**3,579**		**1,020**	
Inorganics (%)														
Total Organic Carbon (Run 1)	**1.5**		**7.4**		**4.0**		**5.3**		**8.5**		**8.0**		**5.2**	
Total Organic Carbon (Run 2)	**1.8**		**7.5**		**4.1**		**5.5**		**8.7**		**8.2**		**5.3**	

SAMPLE ID (1)	Freshwater Criteria (1): McDonald (2) TEC Consensus Effect Concentr.	McDonald (2) PEC Probable Effect Concentr.	1999 NOAA SQUIRTs, 1999 (3) TEL Lowest ARCs *H.azteca*	TEL Threshold Effects Level	PEL Probable Effects Level	UET Upper Effects Threshold		Marine Water Criteria: 1999 NOAA SQUIRTs, 1999 (3) TEL Threshold Effects Level	ERL Effects Range-Low	PEL Probable Effects Level	ERM Effect Range-Median	AET Apparent Effects Threshold (4)		Barrick, 1988 (7) AET-L Apparent Effects Threshold - Low (4)	AET-H Apparent Effects Threshold - High (4)
Semi-Volatile Organics by 8270 - SIM (ug/kg)															
Naphthalene	176	561	15			600	I	35	160	391	2,100	230	E	2,100 O	2,700 X
2-Methylnaphthalene								20	70	201	670	64	E		
Acenaphthylene						160	M	6	44	128	640	71	E	1,300 AX	1,300 AX
Acenaphthene						290	M	7	16	89	500	130	E	500 A	2,000 A
Fluorene	77	536	10			300	M	21	19	144	540	120	E	540 O	3,600 A
Phenanthrene	204	1,170	19	42	515	800	I	87	240	544	1,500	660	E	1,500 O	6,900 A
Anthracene	57	845	10			260	M	47	85	245	1,100	280	E	960 O	13,000 A
Fluoranthene	423	2,230	31	111	2,355	1,500	M	113	600	1,494	5,100	1,300	E	2,500 O	30,000 A
Pyrene	195	1,520	44	53	875	1,000	I	153	665	1,398	2,600	2,400	E	3,300 O	16,000 AX
Benz[a]anthracene	108	1,050	16	32	385	500	I	75	261	693	1,600	960	E		
Chrysene	166	1,290	27	57	862	800	I	108	384	846	2,800	950	E	2,800 O	9,200 AX
Benzo[b]fluoranthene	27	13,400										1,800	EI	3,600 O	9,900 X
Benzo[k]fluoranthene			27			13,400	B					1,800	EI	3,600 O	9,900 X
Benzo[a]pyrene			32	32	782	700	I	89	430	763	1,600	1,100	E	1,600 O	3,600 X
Indeno[1,2,3-cd]pyrene			17			330	M					600	M	690 O	2,600 X
Dibenz[a,h]anthracene	33		10			100	M	6.2	63	135	260	230	OM		
Benzo[g,h,i]perylene						300	M					670	M	720 O	2,600 X
Total PAH	1,610	22,800	264			12,000	M	1,684	4,022	16,770	44,792				

Notes:

(1) Analysis from all samples presented on this table were conducted based on composite samples.
(2) MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, Development and Evaluation of Consensus-based Sediment Quality Guidelines for Freshwater Ecosystems. *Archives of Environmental Contamination and Toxicology*, **39** 20-31.
(3) Buchman, M.F., 1999, NOAA Screening Quick Reference Tables, NOAA HAZMAT report 99-1, Seattle, WA. Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12p.
(4) Effect is lowest value among AET levels: I - Infaunal community impacts; A - Amphipod; B - Bivalve; M - Microtox; O - Oyster larvae; E - Echinoderm Larvae; L - $Larval_{max}$; N - *Neanthes* bioassays; x - Benthic organisms
(5) Measured concentrations could be lab-induced issue (pers. comm, Liz Porter, Alpha Lab, 17-Jan-06).
(6) Source for TEC for Barium: USEPA, 1977 (from Lori Siegel, NHDES)
(7) Barrick, R., S. Becker, L. Brown, H. Beller, and R. Pastorok, 1988, Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET. V. 1, Prepared for the Puget Sound Estuary Program (data taken from USEPA, 1997)

Lab Flags:
J = Estimated value, below quantification limit.
B = Found in the associated blank as well as sample.
U = The analyte was analyzed for but not detected at the sample specific level reported.
P = Greater than 40% RPD between the two columns, the higher value is reported according to the method
I = Due to interference , the lower value is reported.

Data:
5 No-bold: Undetected.
66 Bold: A concentration was detected above the reporting limit.

Exceedance of Freshwater guideline values:
66 Bold: A detected concentration exceeded the freshwater TEC.
66 Bold: A detected concentration exceeded the freshwater PEC.

Exceedance of Saltwater guideline values:
66 Bold in blue field: A detected concentration exceeded the marine water TEL.
66 Bold in red field: A detected concentration exceeded the marine water PEL.

THE Louis Berger Group, INC.

Notes: Sampling Date: 30-Nov-06 (TR-S1 to TR-S5)
19-Apr-07 (TR-S6 to TR-S11)

Table 9 – Taylor River Pond Dam Impoundment
Sediment Quality - Hazard Quotient

SAMPLE ID	TR-S1				TR-S5				TR-S2				TR-S4				TR-S6				TR-S7				TR-S11			
	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL
	Downstream of Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment			
	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level
Metals (mg/kg)																												
Arsenic	1.23	0.36	1.66	0.29	3.68	1.09	4.97	0.87	1.74	0.52	2.35	0.41	2.45	0.73	3.31	0.58	2.86	0.85	3.87	0.67	2.66	0.79	3.59	0.63	2.15	0.64	2.90	0.50
Barium *(6)*	1.80				6.50				4.15				2.10				6.00				6.00				4.35			
Cadmium	0.16	0.03	0.24	0.04	1.21	0.24	1.78	0.29	0.54	0.11	0.78	0.13	0.19	0.04	0.28	0.05	0.88	0.17	1.29	0.21	0.98	0.19	1.43	0.23	0.56	0.11	0.81	0.13
Chromium	0.92	0.36	0.76	0.25	1.01	0.40	0.84	0.27	0.65	0.25	0.54	0.17	0.78	0.31	0.65	0.21	0.85	0.33	0.71	0.23	0.88	0.34	0.73	0.24	0.83	0.32	0.69	0.22
Copper	0.44	0.09	0.75	0.13	1.11	0.23	1.87	0.32	0.57	0.12	0.96	0.17	0.47	0.10	0.80	0.14	0.89	0.19	1.50	0.26	0.89	0.19	1.50	0.26	0.60	0.13	1.02	0.18
Lead	0.70	0.20	0.83	0.22	2.43	0.68	2.88	0.78	0.89	0.25	1.06	0.29	0.25	0.07	0.29	0.08	1.68	0.47	1.98	0.53	1.56	0.44	1.85	0.50	0.92	0.26	1.09	0.29
Mercury	0.09	0.02	0.13	0.02	1.17	0.20	1.62	0.30	0.53	0.09	0.73	0.14	0.22	0.04	0.30	0.06	1.44	0.25	2.00	0.37	1.17	0.20	1.62	0.30	0.67	0.11	0.92	0.17
Nickel	1.23	0.58	1.76	0.65	1.67	0.78	2.39	0.89	0.93	0.43	1.32	0.49	1.10	0.51	1.57	0.58	1.37	0.64	1.95	0.72	1.37	0.64	1.95	0.72	1.28	0.60	1.82	0.68
Zinc	0.55	0.14	0.53	0.24	1.98	0.52	1.94	0.89	0.91	0.24	0.89	0.41	0.46	0.12	0.45	0.21	1.49	0.39	1.45	0.66	1.49	0.39	1.45	0.66	1.07	0.28	1.05	0.48
Pesticides by 8081 (ug/kg)																												
4,4'-DDD	0.31	0.05	1.23	0.19	4.92	0.86	19.67	3.07	1.39	0.24	5.57	0.87	0.55	0.10	2.21	0.35	2.46	0.43	9.84	1.54	1.05	0.18	4.18	0.65	0.51	0.09	2.05	0.32
4,4'-DDE	2.37	0.24	3.62	0.02	19.30	1.95	29.47	0.16	5.06	0.51	7.73	0.04	0.85	0.09	1.30	0.01	6.96	0.70	10.63	0.06	6.01	0.61	9.18	0.05	1.93	0.19	2.95	0.02
4,4'-DDT	0.99	0.07	3.45	0.86	3.85	0.25	13.45	3.35	2.09	0.14	7.31	1.82	0.65	0.04	2.27	0.57	0.53	0.03	1.85	0.46	0.36	0.02	1.26	0.31	0.43	0.03	1.51	0.38
Aldrin																												
alpha-BHC																												
alpha-Chlordane																												
beta-BHC																												
delta-BHC																												
Dieldrin																												
Endosulfan I																												
Endosulfan II																												
Endosulfan sulfate																												
Endrin																												
Endrin aldehyde																												
Endrin ketone																												
gamma-BHC (Lindane)																												
gamma-Chlordane																												
Heptachlor																												
Heptachlor epoxide (B)																												
Methoxychlor																												
Toxaphene																												
Polychlorinated Biphenyls by 8082 (ug/kg)																												
Aroclor 1016																												
Aroclor 1221																												
Aroclor 1232																												
Aroclor 1242																												
Aroclor 1248																												
Aroclor 1254																												
Aroclor 1260																												
Total PCBs																												
Semi-Volatile Organics by 8270 (ug/kg)																												
bis(2-Chloroethyl)ether																												
Phenol																												
2-Chlorophenol																												
1,3-Dichlorobenzene																												
1,4-Dichlorobenzene																												
1,2-Dichlorobenzene																												

Table 9 – Taylor [illegible]r Pond Dam Impoundment
Sediment Quali[illegible] Hazard Quotient

SAMPLE ID	TR-S1				TR-S5				TR-S2				TR-S4				TR-S6				TR-S7				TR-S11			
	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL
	Downstream of Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment			
	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level
Benzyl alcohol																												
bis(2-chloroisopropyl)ether																												
2-Methylphenol																												
Hexachloroethane																												
n-Nitroso-di-n-propylamine																												
4-Methylphenol																												
Nitrobenzene																												
Isophorone																												
2-Nitrophenol																												
2,4-Dimethylphenol																												
Benzoic acid *(5)*																												
bis(2-Chloroethoxy)methane																												
2,4-Dichlorophenol																												
1,2,4-Trichlorobenzene																												
Naphthalene																												
4-Chloroaniline																												
Hexachlorobutadiene																												
4-Chloro-3-methylphenol																												
2-Methylnaphthalene																												
Hexachlorocyclopentadiene																												
2,4,6-Trichlorophenol																												
2,4,5-Trichlorophenol																												
2-Chloronaphthalene																												
2-Nitroaniline																												
Dimethylphthalate																												
2,6-Dinitrotoluene																												
3-Nitroaniline																												
2,4-Dinitrophenol																												
Dibenzofuran																												
2,4-Dinitrotoluene																												
4-Nitrophenol																												
4-Chlorophenyl-phenylether																												
Diethylphthalate																												
4-Nitroaniline																												
4,6-Dinitro-2-methylphenol																												
n-Nitrosodiphenylamine																												
4-Bromophenyl-phenylether																												
Hexachlorobenzene																												
Pentachlorophenol																												
Carbazole																												
Di-n-butylphthalate																												
Butylbenzylphthalate																												
3,3'-Dichlorobenzidine																												
bis(2-Ethylhexyl)phthalate																												
Di-n-octylphthalate																												
Acenaphthylene																												
Acenaphthene																												
Fluorene																												
Phenanthrene																												
Anthracene																												
Fluoranthene																												
Pyrene																												
Benz[a]anthracene																												

(also analyzed with the more sensitive Method 8270 - see below)

Table 9 – Taylor River Pond Dam Impoundment
Sediment Quality - Hazard Quotient

SAMPLE ID	TR-S1				TR-S5				TR-S2				TR-S4				TR-S6				TR-S7				TR-S11			
	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL	TEC	PEC	TEL	PEL
	Downstream of Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment				Lower Impoundment			
	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level	Consensus Effect Concentr.	Probable Effect Concentr.	Threshold Effects Level	Probable Effects Level
Chrysene																												
Benzo[b]fluoranthene																												
Benzo[k]fluoranthene																												
Benzo[a]pyrene																												
Indeno[1,2,3-cd]pyrene																												
Dibenz[a,h]anthracene																												
Benzo[g,h,i]perylene																												
Semi-Volatile Organics by 8270 - SIM (ug/kg)																												
Naphthalene					0.11	0.04	0.58	0.05	0.11	0.03	0.55	0.05					0.08	0.02	0.40	0.04	0.11	0.04	0.58	0.05	0.03	0.01	0.15	0.01
2-Methylnaphthalene											0.69	0.07							0.49	0.05			0.79	0.08				
Acenaphthylene		0.04	1.19	0.05		0.48	13.12	0.60		0.88	23.85	1.09						0.24	6.47	0.30		0.69	18.74	0.86		0.11	3.07	0.14
Acenaphthene										0.05	2.09	0.16										0.06	2.53	0.19				
Fluorene									0.32	0.05	1.18	0.17					0.23	0.03	0.85	0.12	0.49	0.07	1.79	0.26	0.11	0.02	0.40	0.06
Phenanthrene	0.06	0.01	0.14	0.02	0.54	0.09	1.27	0.20	1.76	0.31	4.15	0.66					0.74	0.13	1.73	0.28	2.11	0.37	4.96	0.79	0.28	0.05	0.67	0.11
Anthracene	0.07	0.00	0.08	0.02	0.94	0.06	1.15	0.22	1.92	0.13	2.35	0.45					2.27	0.15	2.77	0.53	2.62	0.18	3.20	0.61	0.17	0.01	0.21	0.04
Fluoranthene	0.07	0.01	0.27	0.02	0.73	0.14	2.75	0.21	1.70	0.32	6.38	0.48					0.57	0.11	2.13	0.16	1.51	0.29	5.67	0.43	0.38	0.07	1.42	0.11
Pyrene	0.15	0.02	0.19	0.02	1.54	0.20	1.97	0.21	3.54	0.45	4.52	0.49	0.06	0.01	0.08	0.01	1.13	0.14	1.44	0.16	3.03	0.39	3.86	0.42	0.72	0.09	0.92	0.10
Benz[a]anthracene	0.17	0.02	0.24	0.03	0.83	0.09	1.20	0.13	2.04	0.21	2.94	0.32					0.59	0.06	0.86	0.09	1.85	0.19	2.67	0.29	0.69	0.07	0.99	0.11
Chrysene	0.19	0.02	0.30	0.04	0.96	0.12	1.48	0.19	1.99	0.26	3.06	0.39					0.72	0.09	1.11	0.14	1.93	0.25	2.97	0.38	0.60	0.08	0.93	0.12
Benzo[b]fluoranthene	1.43	0.00		0.02	5.88	0.01		0.09	9.19	0.02		0.14					4.41	0.01		0.07	9.56	0.02		0.14	4.41	0.01		0.07
Benzo[k]fluoranthene	1.10	0.00		0.02	4.78	0.01		0.07	9.19	0.02		0.14					2.72	0.01		0.04	7.35	0.01		0.11	2.57	0.01		0.04
Benzo[a]pyrene	0.56	0.03	0.20	0.02	4.01	0.19	1.46	0.17	8.02	0.37	2.93	0.34					2.07	0.10	0.75	0.09	6.48	0.30	2.36	0.28	2.35	0.11	0.86	0.10
Indeno[1,2,3-cd]pyrene	1.85	0.10		0.05	8.08	0.42		0.23	12.70	0.67		0.37					3.41	0.18		0.10	9.82	0.52		0.28	4.62	0.24		0.13
Dibenz[a,h]anthracene	0.70	0.23	3.70	0.17	0.91	0.30	4.82	0.22	1.58	0.52	8.36	0.39					0.33	0.11	1.77	0.08	1.15	0.38	6.11	0.28	0.45	0.15	2.41	0.11
Benzo[g,h,i]perylene		0.12		0.05		0.47		0.21		0.70		0.31						0.21		0.10		0.57		0.25		0.25		0.11
Total PAH	0.20	0.01	0.19	0.02	1.19	0.08	1.13	0.11	2.41	0.17	2.31	0.23					0.87	0.06	0.84	0.08	2.22	0.16	2.13	0.21	0.63	0.04	0.61	0.06

Key:

1.90 Exceedance of TEC (Consensus Effect Concentration) - Freshwater

1.90 Exceedance of PEC (Probable Effect Concentration) - Freshwater

1.90 Exceedance of TEL (Consensus Effect Concentration) - Marine water

1.90 Exceedance of PEL (Probable Effect Concentration) - Marine water

THE Louis Berger Group, INC.

Table 10 – Taylor River Pond Dam Impoundment
Sediment Quality - Volatile Organic Compounds

SAMPLE ID (1)	Sediment Concentrations in Taylor River Impoundment										Freshwater Criteria (using Corg/Water Partitioning Coefficient)				Marine Water Criteria (using Corg/Water Partitioning Coefficient)				Barrick, et al., 1988 (4)		K_{oc} (L/kg)	Ambient Water Quality Criteria (2)		SQAL
	TR-S1		TR-S2		TR-S5		TR-S4		Trip Blank		TR-S1	TR-S2	TR-S5	TR-S4	TR-S1	TR-S2	TR-S5	TR-S4	AET-L	AET-H	Soil C_{org}/water Partition Coefficient (6)	Chronic Criteria (CCC) (ug/L)		(ug/g_{oc})
	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual									Apparent Effects Threshold - Low (3)	Apparent Effects Threshold - High (3)		Fresh-water	Marine	USEPA, 1997
Volatile Organics by 8260 (ug/kg) (Range of Method Detection Limits for these compounds: 0.13 - 0.97 ug/kg)																								
Dichlorodifluoromethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Chloromethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Vinyl chloride	1.8	U	10	U	21	U	9.8	U	2.0	U											1.86E+01			
Bromomethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Chloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Trichlorofluoromethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Acetone (5)	**3.2**	JB	**200**	B	**21**	JB	25	U	5.0	U											5.75E-01			
1,1-Dichloroethene	1.8	U	10	U	21	U	9.8	U	2.0	U														
Carbon disulfide	1.8	U	**24**		21	U	9.8	U	2.0	U											4.57E+01			
Methylene chloride	**1.3**	JB	**8.6**	JB	51	U	25	U	**1.9**	JB					1,236	3,033	5,579	4,044			1.17E+01		6,400	
Methyl tert-butyl ether (MTB	1.8	U	10	U	21	U	9.8	U	2.0	U														
trans-1,2-Dichloroethene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,1-Dichloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U											3.16E+01			
Vinyl acetate	1.8	U	10	U	21	U	9.8	U	2.0	U											5.25E+00			
2-Butanone (MEK)	1.8	U	**53**		21	U	9.8	U	2.0	U														
cis-1,2-Dichloroethene	1.8	U	10	U	21	U	9.8	U	2.0	U														
2,2-Dichloropropane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Chloroform	1.8	U	10	U	21	U	9.8	U	2.0	U	814	1,999	3,677	2,665							3.98E+01	1,240		
1,1,1-Trichloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U											1.10E+02			17,000
1,1-Dichloropropene	1.8	U	10	U	21	U	9.8	U	2.0	U														
Carbon tetrachloride	1.8	U	10	U	21	U	9.8	U	2.0	U											1.74E+02			
Benzene	1.8	U	10	U	21	U	9.8	U	2.0	U					680	1,670	3,072	2,226			5.89E+01		700	
1,2-Dichloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U	5,742	14,094	25,926	18,792							1.74E+01	20,000		
Trichloroethene	1.8	U	10	U	21	U	9.8	U	2.0	U														210,000
Dibromomethane	1.8	U	10	U	21	U	9.8	U	2.0	U													6,400	
1,2-Dichloropropane	1.8	U	10	U	21	U	9.8	U	2.0	U											4.37E+01			
Bromodichloromethane	1.8	U	10	U	21	U	9.8	U	2.0	U											5.50E+01			
2-Chloroethylvinyl ether	1.8	U	10	U	21	U	9.8	U	2.0	U														
Methyl isobutyl ketone (MIB	1.8	U	10	U	21	U	9.8	U	2.0	U														
cis-1,3-Dichloropropene	1.8	U	10	U	21	U	9.8	U	2.0	U														
Toluene	1.8	U	10	U	21	U	9.8	U	2.0	U					15,015	36,855	67,795	49,140			1.82E+02		5,000	89,000
trans-1,3-Dichloropropene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,1,2-Trichloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U	7,771	19,073	35,085	25,431							5.01E+01	9,400		
2-Hexanone	1.8	U	10	U	21	U	9.8	U	2.0	U														
Tetrachloroethene	1.8	U	10	U	21	U	9.8	U	2.0	U									57 X	140 O				53,000
1,3-Dichloropropane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Dibromochloromethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,2-Dibromoethane	1.8	U	10	U	21	U	9.8	U	2.0	U														
Chlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U	181	443	816	591	466	1,144	2,105	1,526			2.19E+02	50	129	82,000
1,1,1,2-Tetrachloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U														160,000
Ethylbenzene	**2.2**		**13**		21	U	9.8	U	**3.5**										10 X	37 O	3.63E+02			480,000
p/m-Xylene	**7.6**		**40**		41	U	20	U	**12**										40 X	120 O	4.00E+02			2,500
o-Xylene	**1.4**	J	**7.2**	J	21	U	9.8	U	**1.9**	J									40 X	120 O	3.63E+02			2,500
Styrene	1.8	U	10	U	21	U	9.8	U	2.0	U											7.76E+02			
Bromoform	1.8	U	10	U	21	U	9.8	U	2.0	U											8.71E+01			
Isopropylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,1,2,2-Tetrachloroethane	1.8	U	10	U	21	U	9.8	U	2.0	U	3,695	9,069	16,682	12,092							9.33E+01	2,400		
Bromobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,2,3-Trichloropropane	1.8	U	10	U	21	U	9.8	U	2.0	U														

Table 10 – Taylor River Pond Dam Impoundment
Sediment Quality - Volatile Organic Compounds

SAMPLE ID *(1)*	Sediment Concentrations in Taylor River Impoundment										Freshwater Criteria (using Corg/Water Partitioning Coefficient)				Marine Water Criteria (using Corg/Water Partitioning Coefficient)				Marine Water Criteria Barrick, et al., 1988 *(4)*		K_{oc} (L/kg)	Ambient Water Quality Criteria *(2)* Chronic Criteria (CCC) (ug/L)		SQAL (ug/g_{oc})
	TR-S1		TR-S2		TR-S5		TR-S4		Trip Blank		TR-S1	TR-S2	TR-S5	TR-S4	TR-S1	TR-S2	TR-S5	TR-S4	AET-L Apparent Effects Threshold - Low *(3)*	AET-H Apparent Effects Threshold - High *(3)*	Soil C_{org}/water Partition Coefficient *(6)*	Fresh-water	Marine	USEPA, 1997
	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual	Conc.	Qual														
n-Propylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
2-Chlorotoluene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,3,5-Trimethylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
4-Chlorotoluene	1.8	U	10	U	21	U	9.8	U	2.0	U														
tert-Butylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,2,4-Trimethylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
sec-Butylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,3-Dichlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
p-Isopropyltoluene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,4-Dichlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U	7,768	19,066	35,072	25,422	1,313	3,224	5,930	4,298			6.17E+02	763	129	
n-Butylbenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,2-Dichlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U	7,768	19,066	35,072	25,422	1,313	3,224	5,930	4,298	50 OX	50 OX	6.17E+02	763	129	34,000
1,2-Dibromo-3-chloropropar	1.8	U	10	U	21	U	9.8	U	2.0	U														
1,2,4-Trichlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U	1,469	3,605	6,631	4,806	3,789	9,300	17,107	12,399	51 A	64 O	1.78E+03	50	129	920,000
Hexachlorobutadiene	1.8	U	10	U	21	U	9.8	U	2.0	U									11 X	270 O		9.3		
1,2,3-Trichlorobenzene	1.8	U	10	U	21	U	9.8	U	2.0	U														
Naphthalene	1.8	U	10	U	**25**		9.8	U	2.0	U	(also analyzed with Method 8270) (see **Table 7&8**)													

Notes:

(1) Analysis for the Volatile Organics were conducted from individual samples: VOCs from samples TR-S1, TR-S2, and TRS4 were obtained from the respective subsample 2 of 3; VOCs from sample TR-S5 were obtained from subsample 1 of 2.
(2) *Buchman, M.F., 1999, NOAA Screening Quick Reference Tables, NOAA HAZMAT report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12p.*
(3) Sediment concentration based on: A - Amphipod; O - Oyster; X - Benthic organisms
(4) Barrick, R., S. Becker, L. Brown, H. Beller,and R. Pastorok, 1988, Sediment quality values refinement: 1988 update and evaluation of Puget Sound AET. V. 1, Prepared for the Puget Sound Estuary Program (data taken from USEPA, 1997)
(5) Measured concentations could be lab-induced issue (pers. comm, Liz Porter, Alpha Lab, 17-Jan-06).

(6) Source: USEPA, 1996, Soil Screening Guidance: User's Guide.

Lab Flags: J = Estimated value, below quantification limit.
B = Found in the associated blank as well as sample.
U = The analyte was analyzed for but not detected at the sample specific level reported.

Data: 5 No-bold: Undected.
66 Bold: A concentration was detected above the reporting limit.

Notes: Sampling Date: November 30, 2006

THE Louis Berger Group, INC.

Table 11: Taylor River - Fish Sampling in Spring 2007

Date	Time Electrofished	Hours Soaked	Temp (oC)	Species	T. Length (mm)	WT (gm)	Sample #
Electrofishing (1)							
4/25/2007	1030-1300		15	LMB	276	253	1
4/25/2007	1030-1300		15	LMB	270	264	2
4/25/2007	1030-1300		15	LMB	303	307	3
4/25/2007	1030-1300		15	LMB	248	180	4
4/25/2007	1030-1300		15	LMB	271	243	5
4/25/2007	1030-1300		15	LMB	276	285	6
4/25/2007	1030-1300		15	LMB	241	160	7
4/25/2007	1030-1300		15	LMB	292	304	8
4/25/2007	1030-1300		15	LMB	301	351	9
4/25/2007	1030-1300		15	LMB	310	372	10
4/25/2007	1030-1300		15	LMB	245	157	11
4/25/2007	1030-1300		15	LMB	246	190	12
4/25/2007	1030-1300		15	ECP	161	21	1w
4/25/2007	1030-1300		15	ECP	146	14	2w
4/25/2007	1030-1300		15	ECP	145	15	3w
4/25/2007	1030-1300		15	LMB	138	26	4w
4/25/2007	1030-1300		15	ECP	170	23	5w
4/25/2007	1030-1300		15	LMB	132	28	6w
4/25/2007	1030-1300		15	ECP	157	18	7w
4/25/2007	1030-1300		15	ECP	164	24	8w
4/25/2007	1030-1300		15	ECP	143	13	9w
4/25/2007	1030-1300		15	ECP	167	23	10w
4/25/2007	1030-1300		15	ECP	175	24	11w
4/25/2007	1030-1300		15	LMB	135	25	12w
4/25/2007	1030-1300		15	LMB	152	39	13w
4/25/2007	1030-1300		15	ECP	245	79	14w
4/25/2007	1030-1300		15	ECP	311	164	15w
4/25/2007	1030-1300		15	LMB	156	46	16w
4/25/2007	1030-1300		15	LMB	223	117	17w
4/25/2007	1030-1300		15	LMB	205	92	18w
4/25/2007	1030-1300		15	LMB	187	73	19w
4/25/2007	1030-1300		15	ECP	170	26	20w
4/25/2007	1030-1300		15	ECP	218	47	21w
4/25/2007	1030-1300		15	LMB	143	25	22w
4/25/2007	1030-1300		15	ECP	256	87	23w
Gill Net (2)							
5/10/2007	1000	24	21	ECP	361		
5/10/2007	1000	24	21	ECP	446		
5/10/2007	1000	24	21	ECP	503		
5/10/2007	1000	24	21	ECP	358		
5/10/2007	1000	24	21	ECP	344		
5/10/2007	1000	24	21	ECP	341		
5/10/2007	1000	24	21	ECP	500		
5/10/2007	1000	24	21	ECP	420		
5/10/2007	1000	24	21	ECP	448		
5/10/2007	1000	24	21	ECP	376		
5/10/2007	1000	24	21	ECP	381		
5/10/2007	1000	24	21	ECP	*		
5/10/2007	1000	24	21	ECP	*		
5/10/2007	1000	24	21	ECP	*		
5/10/2007	1000	24	21	GS	232		
5/10/2007	1000	24	21	GS	212		
5/10/2007	1000	24	21	GS	*		
5/10/2007	1000	24	21	RH	299		

BBH	-Brown Bullhead
BC	-Black Crappie
BG	-Bluegill
ECP	-Eastern Chain Pickerel
GS	-Golden Shiner
LMB	-Largemouth Bass
PMK	-Pumpkinseed
RBS	-Redbreasted Sunfish
RH	-River Herring
UNK	-Unknown

Date	Time Electrofished	Hours Soaked	Temp (oC)	Species	T. Length (mm)	WT (gm)	Sample #
5/10/2007	1000	24	21	RH	289		
5/10/2007	1000	24	21	RH	264		
5/10/2007	1000	24	21	RH	*		
5/10/2007	1000	24	21	BBH	235	166	36
5/10/2007	1000	24	21	BG	*		
5/11/2007	1100	25	19	ECP	468	605	
5/11/2007	1100	25	19	ECP	440	498	
5/11/2007	1100	25	19	ECP	573	1212	
5/11/2007	1100	25	19	ECP	*		
5/11/2007	1100	25	19	BBH	290	357	37
5/11/2007	1100	25	19	BBH	*		
5/11/2007	1100	25	19	RH	283	218	
5/11/2007	1100	25	19	GS	*		
5/11/2007	1100	25	19	BG	*		
5/15/2007	1000	23	17	RH	282	200	
5/15/2007	1000	23	17	RH	311	300	
5/15/2007	1000	23	17	RH	272	200	
5/15/2007	1000	23	17	RH	263	150	
5/15/2007	1000	23	17	RH	*		
5/15/2007	1000	23	17	RH	*		
5/15/2007	1000	23	17	RH	*		
5/15/2007	1000	23	17	RH	*		
5/15/2007	1000	23	17	RH	*		
5/15/2007	1000	23	17	LMB	210	150	
5/15/2007	1000	23	17	ECP	427	450	
5/15/2007	1000	23	17	ECP	393	400	
5/15/2007	1000	23	17	GS	222		
5/15/2007	1000	23	17	PMK	163	100	
5/15/2007	1000	23	17	PMK	*		
5/15/2007	1000	23	17	PMK	*		
5/16/2007	1000	24	13	ECP	473		
5/16/2007	1000	24	13	BG	226		
5/16/2007	1000	24	13	RBS	149		
5/16/2007	1000	24	13	RBS	142		
5/17/2007	1030	24.5	14	RH	305	150	
5/17/2007	1030	24.5	14	RH	268	150	
5/17/2007	1030	24.5	14	RH	293	150	
5/17/2007	1030	24.5	14	RH	277	150	
5/17/2007	1030	24.5	14	RH	304	250	
5/17/2007	1030	24.5	14	RH	271	200	
5/17/2007	1030	24.5	14	RH	293	150	
5/17/2007	1030	24.5	14	RH	*		
5/17/2007	1030	24.5	14	RH	*		
5/17/2007	1030	24.5	14	RH	*		
5/17/2007	1030	24.5	14	RH	*		
5/17/2007	1030	24.5	14	PMK	*		
5/17/2007	1030	24.5	14	GS	*		
5/18/2007	1300	26.5	11	No fish present			
5/30/2007	930	24	22	BC	335		
5/30/2007	930	24	22	BBH	248	291	38
5/30/2007	930	24	22	BBH	267	295	39
5/30/2007	930	24	22	ECP	*		
5/30/2007	930	24	22	ECP	*		
5/30/2007	930	24	22	ECP	*		
5/30/2007	930	24	22	PMK	*		
5/31/2007	1100	22.5	22	ECP	391		
5/31/2007	1100	22.5	22	ECP	368		

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RBS	-Redbreasted Sunfish
RH	-River Herring
UNK	-Unknown

Date	Time Electrofished	Hours Soaked	Temp (oC)	Species	T. Length (mm)	WT (gm)	Sample #
5/31/2007	1100	22.5	22	ECP	*		
5/31/2007	1100	22.5	22	LMB	280		
5/31/2007	1100	22.5	22	BBH	*		
6/1/2007	1530	28.5	24	ECP	396		
6/1/2007	1530	28.5	24	ECP	410		
6/1/2007	1530	28.5	24	ECP	398		
6/1/2007	1530	28.5	24	ECP	463		
6/1/2007	1530	28.5	24	ECP	418		
6/1/2007	1530	28.5	24	GS	238		
6/1/2007	1530	28.5	24	GS	207		
6/1/2007	1530	28.5	24	GS	*		
6/1/2007	1530	28.5	24	LMB	*		
6/2/2007	1530	24	25	ECP	461		
6/2/2007	1530	24	25	PMK	129		
6/2/2007	1530	24	25	PMK	120		
6/2/2007	1530	24	25	PMK	166		
6/2/2007	1530	24	25	PMK	*		
6/3/2007	1400	22.5	20	GS	*		
6/3/2007	1400	22.5	20	GS	*		
6/4/2007	1230	22.5	16	ECP	354		
6/4/2007	1230	22.5	16	ECP	*		
6/4/2007	1230	22.5	16	BG	*		
6/5/2007	1345	25.25	15	ECP	356		
6/5/2007	1345	25.25	15	ECP	495		
6/5/2007	1345	25.25	15	ECP	*		
6/5/2007	1345	25.25	15	RH	289		
6/5/2007	1345	25.25	15	LMB			
6/6/2007	1230	22.75	16	ECP	518		
6/6/2007	1230	22.75	16	ECP	383		
6/6/2007	1230	22.75	16	ECP	385		
6/6/2007	1230	22.75	16	ECP	*		
6/6/2007	1230	22.75	16	ECP	*		
6/6/2007	1230	22.75	16	ECP	*		
6/6/2007	1230	22.75	16	ECP	*		
6/7/2007	1530	27	19	PMK	*		
6/7/2007	1530	27	19	RH	*		
6/7/2007	1530	27	19	ECP	468		
6/8/2007	1200	20.5	18	PMK	130		
6/8/2007	1200	20.5	18	GS	223		
6/8/2007	1200	20.5	18	ECP	383		
6/8/2007	1200	20.5	18	BBH	168	67	**40**
6/9/2007	830	20.5	18	ECP	*		
6/9/2007	830	20.5	18	ECP	*		
6/9/2007	830	20.5	18	RH	278		
6/10/2007	1330	29	17	PMK	*		
6/10/2007	1330	29	17	BG	*		
6/10/2007	1330	29	17	BG	*		
6/10/2007	1330	29	17	BG	*		
6/10/2007	1330	29	17	ECP	*		
6/10/2007	1330	29	17	BBH	185	98	**41**
6/10/2007	1330	29	17	BBH	188	105	**42**
6/11/2007	1400	24.5	20	PMK	*		
6/11/2007	1400	24.5	20	BG	*		
6/11/2007	1400	24.5	20	ECP	324		
6/11/2007	1400	24.5	20	BBH	270	313	**43**
6/12/2007	1045	20.75	19	BC	*		
6/12/2007	1045	20.75	19	BBH	253	293	**44**

BBH	-Brown Bullhead
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PMK	-Pumpkinseed
RBS	-Redbreasted Sunfish
RH	-River Herring
UNK	-Unknown

Date	Time Electrofished	Hours Soaked	Temp (oC)	Species	T. Length (mm)	WT (gm)	Sample #
6/12/2007	1045	20.75	19	UNK	*		
6/12/2007	1045	20.75	19	UNK	*		
6/12/2007	1045	20.75	19	Snapping Turtle			
6/14/2007	1030	47.75	15	PMK	*		
6/14/2007	1030	47.75	15	PMK	*		
6/14/2007	1030	47.75	15	LMB	*		
6/16/2007	1100	48.5	18	ECP	*		
6/16/2007	1100	48.5	18	ECP	*		
6/16/2007	1100	48.5	18	ECP	425		
6/16/2007	1100	48.5	18	ECP	373		
6/16/2007	1100	48.5	18	BG	*		
6/16/2007	1100	48.5	18	PMK	*		
6/16/2007	1100	48.5	18	BBH	392		
6/16/2007	1100	48.5	18	Snapping Turtle			
6/17/2007	1200	25	22	ECP	340		
6/17/2007	1200	25	22	ECP	332		
6/18/2007	1330	25.5	25	No fish present			
6/20/2007	1530	50	24	PMK	*		
6/21/2007	1300	21.5	24	PMK	*		
6/21/2007	1300	21.5	24	PMK	*		
6/21/2007	1300	21.5	24	BG	*		
6/21/2007	1300	21.5	24	ECP	*		
6/22/2007	1230	23.5	19	BG	*		
6/23/2007	1130	23	20	PMK	*		
6/23/2007	1130	23	20	PMK	*		
6/23/2007	1130	23	20	PMK	*		
6/23/2007	1130	23	20	PMK	*		
6/23/2007	1130	23	20	PMK	*		
6/23/2007	1130	23	20	BC	*		
6/25/2007	1530	52	29	BBH	233	189	**45**
6/25/2007	1530	52	29	BBH	291	291	**46**
6/25/2007	1530	52	29	BBH	254	254	**47**
6/25/2007	1530	52	29	BBH	*		
6/25/2007	1530	52	29	BC	*		
6/25/2007	1530	52	29	ECP	*		
6/25/2007	1530	52	29	GS	*		

(1) *Species Observed:* American eel-Abundant, Golden Shiner, Bluegill, Redbreasted sunfish, Black crappie; *Species not Observed:* Yellow Perch, Common white sucker

(2) No measurement taken (either released alive, or unmeasurable due to partially eaten fish). Field samples do not contain a weight, those worked up in the office were weighed.

Sampling Staff: Cheri Patterson, Mike Dionne, Renee Zobel, Becky Heuss
New Hampshire Fish and Game Department

THE **Louis Berger Group,** INC.

Table 12: Organic Compounds in Fish Tissues in Taylor River Impoundment - Summary of Laboratory Reports (ug/kg

Sample ID	Lab ID	Large Mouth Bass	Eastern Chain Pickerel	Brown Bullhead	Whole Fish	Fillet	alpha BHC	beta BHC	delta BHC	gamma chlordane	2,4' - DDD	4,4' - DDD	*SUM* - DDD	2,4' - DDE	4,4' - DDE	*SUM* - DDE	4,4' - DDT	Dieldrin	Endosulfan I	Heptachlor	Heptachlor epoxide	Hexachloro - benzene	cis Nonachlor	trans Nonachlor	Oxychlordane
TRF-01DL	716576D1	•				•						3.4 D	3.40		21 D	21.0	1.1 D	0.95 D							
TRF-01W	716577		•		•							1.7	1.70		12	12.0	1.4								
TRF-02	716578	•				•						3.1	3.10		25	25.0	2.1	1.0						1.3	
TRF-02W	716579		•		•						0.50	1.6	2.10		11	11.0									
TRF-03	716580	•				•						2.2	2.20		10	10.0	2	0.42						0.57	
TRF-03W	716581		•		•							0.90	0.90		8.5	8.5	0.56								
TRF-04	716582	•				•						2.4	2.40		29	29.0	1.6	0.92						1.1	
TRF-04W	716583	•			•							3.4 P	3.40		33 P	33.0	3.8 P								
TRF-05	716584	•				•						4.8 P	4.80		28 P	28.0	1.3 P	0.87 P							
TRF-05W	716585		•		•							0.87	0.87		6.3	6.3									
TRF-06	716586	•				•					0.46	2.6	3.06		14	14.0	1.2	0.92						0.71	
TRF-06W	716587	•			•						0.46	3.2	3.66		17	17.0	2.1	0.80							
TRF-07	716588	•				•					1.6 P	5.8 P	7.40		33 P	33.0	2.2 P	1.1 P							
TRF-07W	716589		•		•							0.55	0.55		6.2	6.2									
TRF-08	716590	•				•					0.70	2.6	3.30		15	15.0	0.98	0.90							
TRF-08W	716591		•		•							1.0	1.00		8.4	8.4	0.63								
TRF-09	716592	•				•						1.4	1.40		12	12.0	0.60						0.52	0.96	
TRF-09W	716593		•		•							2.0	2.00		11	11.0	1.0	0.55							
TRF-10	716594	•				•			0.5		0.66	2.5	3.16	0.68	17	17.7	1.1 P	0.94						0.83	
TRF-10W	716595		•		•							1.1	1.10		6.0	6.0									
TRF-11	716623R1	•				•						3.3	3.30		30	30.0	2.5								
TRF-11W	716624R1		•		•							0.50	0.50		8.9	8.9	0.93 P								
TRF-12	716625R1					•						4.4	4.40		41	41.0	2.8								
TRF-12W	716626	•			•							0.52	0.52		3.0	3.0									
TRF-13W	716627	•			•						0.93	6.2	7.13		32	32.0	2.5	1.5							
TRF-14W	716628		•		•							3.8	3.80		65	65.0	11							2.6	
TRF-15W	716629		•		•							3.9	· 3.90		38	38.0	7.1							3.4	
TRF16W	716630	•			•							1.6	1.60		14	14.0	1.2 P	0.61							
TRF-17W	716631	•			•							0.93	0.93		16	16.0	1.2 P								
TRF-18W	716632	•			•							2.5	2.50		35	35.0	4.5								
TRF-19W	716633	•			•							1.6	1.60		32	32.0	4.9								
TRF-20W	716634		•		•							2.0	2.00		13	13.0	0.93 P	0.81						0.65	
TRF-21W	716635		•		•							3.2	3.20		32	32.0	3.6								
TRF-22W	716636	•			•							1.8	1.80		18	18.0	2.0	0.46						0.54	
TRF-23W	716637		•		•							2.4	2.40		31	31.0	2.3 P								
TRF-36	716638			•		•					0.45	3.0	3.45		19	19.0	1.5	0.63							
TRF-37	716639			•		•						0.62	0.62		4.6	4.6	0.44								
TRF-38	716640			•		•						1.1	1.10		6.1	6.1	0.58								
TRF-39	716641			•		•						3.6	3.60	1.7 P	17	18.7	2.2	0.83		0.55					
TRF-40	716642			•		•		2.7 P				0.77	0.77		3.0	3.0									
TRF-41	716700			•		•				0.46			0.00		0.70	0.7									
TRF-42	716701			•		•						0.61	0.61		2.8	2.8				1.4					
TRF-43	716702			•		•						1.0	1.00		3.1	3.1		0.44		0.66					
TRF-44	716703			•		•	1.0		2.3 P	0.55	0.96	7.0	7.96		12	12.0	0.59	2.6		3.6	0.46 P				
TRF-45	716704			•		•						1.5	1.50	0.63	6.7	7.3	0.44	0.50		0.56					
TRF-46	716705			•		•						13	13.00		59	59.0	5.5	2.5							
TRF-47	716706			•		•						2.3	2.30	0.65	7.7	8.4		0.72		0.80 P					

3.7 P Greater than 40% difference for detected concentrations between two GC columns. Unless otherwise specified the higher of the two values is reported. Values flagged with a "P" were not used in the data synthesis. The data could reflect interference and thus be higher than afound in the field. .

(*) Reporting limit (RL) for all compounds, with the exceptions of toxaphene. The RL for toxaphene was 125 times the reported RL for all other compounds.

(**) Values below RL were entered as 50% of RL.

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Table 13: Taylor River - Fish Tissue Pesticide Concentrations, as used for Human Health Assessment (ug/kg)

Lab ID	NH ID	2,4' - DDD		4,4' - DDD		2,4' - DDE		4,4' - DDE		2,4' DDT		4,4' - DDT		DDT (total)	Dieldrin		Hepta-chlor		Heptachlor epoxide		Heptachlor (total)	gamma chlordane		cis Nonachlor		trans Nonachlor		Oxy-chlordane		Chlordane (total)
Brown Bullhead - Fillet																														
716638	TRF-36	0.45		3.0		0.2	U	19		0.2	U	1.5		24.4	0.63		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716639	TRF-37	0.2	U	0.62		0.2	U	4.6		0.2	U	0.44		6.3	0.20	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716640	TRF-38	0.2	U	1.1		0.2	U	6.1		0.2	U	0.58		8.4	0.20	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716641	TRF-39	0.2	U	3.6		1.7	P	17		0.2	U	2.2		24.9	0.83		0.6		0.2	U	0.8	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716642	TRF-40	0.225	U	0.77		0.225	U	3.0		0.225	U	0.225	U	4.7	0.23	U	0.2	U	0.2	U	0.5	0.2	U	0.2	U	0.2	U	0.2	U	0.9
716700	TRF-41	0.2	U	0.2	U	0.2	U	0.70		0.2	U	0.2	U	1.7	0.20	U	0.2	U	0.2	U	0.4	0.460		0.2	U	0.2	U	0.2	U	1.1
716701	TRF-42	0.2	U	0.61		0.2	U	2.8		0.2	U	0.2	U	4.2	0.20	U	1.4		0.2	U	1.6	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716702	TRF-43	0.2	U	1.0		0.2	U	3.1		0.2	U	0.2	U	4.9	0.44		0.7		0.2	U	0.9	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716703	TRF-44	0.96		d		0.2	U	12		0.2	U	0.59		21.0	2.60		3.6		0.5	P	4.1	0.550		0.2	U	0.2	U	0.2	U	1.2
716704	TRF-45	0.2	U	1.5		0.63		6.7		0.2	U	0.44		9.7	0.50		0.6		0.2	U	0.8	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716705	TRF-46	1	U	13		1	U	59		1	U	5.5		80.5	2.50		1.0	U	1.0	U	2.0	1.0	U	1.0	U	1.0	U	1.0	U	4.0
716706	TRF-47	0.2	U	2.3		0.65		7.7		0.2		0.2	U	11.3	0.72		0.8	P	0.2	U	1.0	0.2	U	0.2	U	0.2	U	0.2	U	0.8
Largemouth Bass - Fillet																														
716576	TRF-01	0.40	U	3.40	D	0.40	P	21	D	0.40	U	1.10	D	26.7	1.00		0.2	U	0.2	U	0.4	5.700		0.4	U	1.0		0.590		7.6
716578	TRF-02	0.4	U	3.1		0.4	U	25		0.4	U	2.1		31.4	1.00		0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716580	TRF-03	0.2	U	2.2		0.2	U	10		0.2	U	2		14.8	0.42		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.6		0.2	U	1.2
716582	TRF-04	0.4	U	2.4		0.4	U	29		0.4	U	1.6		34.2	0.92		0.4	U	0.4	U	0.8	0.4	U	0.4	U	1.1		0.4	U	2.3
716584	TRF-05	0.4	U	4.8	P	0.4	U	28	P	0.4	U	1.3	P	35.3	0.87	P	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716586	TRF-06	0.46		2.6		0.2	U	14		0.2	U	1.2		18.7	0.92		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.7		0.2	U	1.3
716588	TRF-07	1.6	P	5.8	P	0.4	U	33	P	0.4	U	2.2	P	43.4	1.10	P	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716590	TRF-08	0.70		2.6		0.2	U	15		0.2	U	0.98		19.7	0.90		0.2	U	0.2	U	0.5	0.2	U	0.2	U	0.2	U	0.2	U	0.9
716592	TRF-09	0.21	U	1.4		0.21	U	12		0.21	U	0.60		14.6	0.21	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	1.0		0.2	U	1.6
716594	TRF-10	0.66		2.5		0.68		17		0.4	U	1.1	P	22.3	0.94		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.8		0.2	U	1.5
716623R1	TRF-11	0.4	U	3.3		0.4	U	30		0.4	U	2.5		37.0	0.40	U	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716625R1	TRF-12	0.6	U	4.4		0.6	U	41		0.6	U	2.8		50.0	0.60	U	0.6	U	0.6	U	1.2	0.6	U	0.6	U	0.6	U	0.6	U	2.4
Largemouth Bass - Whole Fish																														
716583	TRF-04w	0.4	U	3.4	P	0.4	U	33	P	0.4	U	3.8	P	41.4	0.4	U	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716587	TRF-06w	0.46		3.2		0.2	U	17		0.2	U	2.1		23.2	0.8		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716626	TRF-12w	0.2	U	0.52		0.2	U	3.0		0.2	U	0.2	U	4.3	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716627	TRF-13w	0.93		6.2		0.4	U	32		0.4	U	2.5		42.4	1.5		0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716630	TRF-16w	0.2	U	1.6		0.2	U	14		0.2	U	1.2	P	17.4	0.6		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716631	TRF-17w	0.2	U	0.93		0.2	U	16		0.2	U	1.2	P	18.7	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716632	TRF-18w	0.6	U	2.5		0.6	U	35		0.6	U	4.5		43.8	0.6	U	0.6	U	0.6	U	1.2	0.6	U	0.6	U	0.6	U	0.6	U	2.4
716633	TRF-19w	0.4	U	1.6		0.4	U	32		0.4	U	4.9		39.7	0.4	U	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716636	TRF-22w	0.2	U	1.8		0.2	U	18		0.2	U	2.0		22.4	0.5		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.5		0.2	U	1.1
Eastern Chain Pickerel - Whole Fish																														
716577	TRF-01w	0.2	U	1.7		0.2	U	12		0.2	U	1.4		15.7	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716579	TRF-02w	0.50		1.6		0.2	U	11		0.2	U	0.2	U	13.7	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716581	TRF-03w	0.2	U	0.90		0.2	U	8.5		0.2	U	0.56		10.6	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716585	TRF-05w	0.2	U	0.87		0.2	U	6.3		0.2	U	0.2	U	8.0	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716589	TRF-07w	0.2	U	0.55		0.2	U	6.2		0.2	U	0.2	U	7.6		U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716591	TRF-08w	0.2	U	1.0		0.2	U	8.4		0.2	U	0.63		10.6	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716593	TRF-09w	0.2	U	2.0		0.2	U	11		0.2	U	1.0		14.6	0.6		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716595	TRF-10w	0.2	U	1.1		0.2	U	6.0		0.2	U	0.2	U	7.9	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716624R1	TRF-11w	0.2	U	0.50		0.2	U	8.9		0.2	U	0.93	P	10.9	0.2	U	0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716628	TRF-14w	1	U	3.8		1	U	65		1	U	11		82.8	1.0	U	1.0	U	1.0	U	2.0	1.0	U	1.0	U	2.6		1.0	U	5.6
716629	TRF-15w	0.6	U	3.9		0.6	U	38		0.6	U	7.1		50.8	0.6	U	0.6	U	0.6	U	1.2	0.6	U	0.6	U	3.4		0.6	U	5.2
716634	TRF-20w	0.2	U	2.0		0.2	U	13		0.2	U	0.93	P	16.5	0.8		0.2	U	0.2	U	0.4	0.2	U	0.2	U	0.2	U	0.2	U	0.8
716635	TRF-21w	0.4	U	3.2		0.4	U	32		0.4	U	3.6		40.0	0.4	U	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6
716637	TRF-23w	0.4	U	2.4		0.4	U	31		0.4	U	2.3	P	36.9	0.4	U	0.4	U	0.4	U	0.8	0.4	U	0.4	U	0.4	U	0.4	U	1.6

Notes: Data shown are in ug/kg wet weight.
U qualifier indicates Non-detect, value is one half the detection limit.
Data for all detected compunds are presented, compounds with no detects omitted.

Table 14: Taylor River - Summary Statistics for Contaminants in Fish Fillets

Species	Contaminant[1]	Number of Samples	Number of Detects	Percent Detects	Average	Maximum	95th% UCL *(Upper Confidence Limit)*	EPA Screening Level[2]	Does 95th UCL Exceed screening level?
					ug/kg	ug/kg	ug/kg	ug/kg	
Brown Bullhead - Fillets									
	DDT (total)	12	12	100	16.8	80.5	30.5	69	No
	Heptachlor (total)	12	6	50	1.10	3.1	1.73	2.6	No
	Dieldrin	12	7	58	0.77	2.6	1.33	1.5	No
Largemouth Bass - Fillets									
	DDT (total)	12	12	100	29.0	48.8	34.8	69	No
	Heptachlor (total)	12	7	58	0.64	1.2	0.78	2.6	No
	Dieldrin	12	9	75	0.78	1.1	1.1	1.5	No
	Chlordane (total)	12	7	d	2.10	7.64	4.4	67	No

Notes:

1. Contaminants shown were detected at a frequency of 10 percent or greater.
Congener totals were calculated using 1/2 the method detection limit for non-detects.
DDT(total) is the sum of dichlorodiphenyltrichloroethane(DDT), dichlorodiphenyldichloroethylene(DDE) and dichlorodiphenyldichloroethane(DDD) congeners.
Heptachlor (total) is the sum of heptachlor and heptachlor epoxide.
Chlordane (total) is the sum of oxychlordane, trans-nonachlor,cis-nonachlor and gamma chlordane.

2. The EPA screening levels represent the maximum allowable intake at the level of the statewide fish consumption advisory (4 meals per month). These values can be found in the Risk Based Consumption Limit Tables, Chapter 3 of the United States Environmental Protection Agency (EPA) Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 2, EPA 823-B-00-008 November 2000.

Table 15: Taylor River - Summary of Data and Ecological Risk

	# of Samples	Average	Maximum	95th%UCL	Fish *(represented by rainbow trout)*	Birds *(represented by Blue Heron)*	Bird *(represented by Osprey)*	Bird eggs *(represented by Osprey eggs)*	Mammals *(represented by Mink)*
		ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg	ug/kg
Brown Bullhead									
DDT (total metabolites)	14	23.33	82.80	35.96	1270	16	14	8.3	4490
Heptachlor (total metabolites)	13	0.65	2.00	0.93					730
Dieldrin	14	0.39	1.00	0.54	1760	438	385		112
Largemouth Bass									
DDT (total metabolites)	9	28.15	43.80	38.98	1270	16	14	8.3	4490
Heptachlor (total metabolites)	9	0.62	1.20	0.85					730
Dieldrin	9	0.58	1.50	0.88	1760	438	385		112

	95th UCL >Fish screening level?	95th UCL >Birds screening level?	95th UCL >Egg screening level?	95th UCL >Mammal screening level?
Brown Bullhead				
DDT (total metabolites)	No	**Yes**	**Yes**	No
Heptachlor (total metabolites)				No
Dieldrin	No	No	No	No
Largemouth Bass				
DDT (total metabolites)	No	**Yes**	**Yes**	No
Heptachlor (total metabolites)				No
Dieldrin	No	No	No	No

Table 16
Taylor River Dam Impoundment

Temperature/DO Profile
Recorded on Taylor River Pond, August 31, 2006

DEPTH (FT)	TEMP (°C)	DO (mg/L)	DO (% Saturation)
0	20.5	7.19	80.7
1	20.3	6.64	73.2
2	19.8	6.67	74.4
3	19.7	6.67	72.4
4	19.7	6.50	71.0
5	19.5	6.24	67.7
6	19.3	5.77	62.9
7	19.3	4.61	50.2
8	18.9	3.52	39.2
9	18.3	1.56	17.2
10	18.0	2.35	25.1
11	18.0	0.72	7.0
12	16.9	0.00	0.0

Source: NH Department of Environmental Services

°C = degrees Celsius
DO = dissolved oxygen
mg/l = milligrams per liter

Table 17
Trophic levels (after Vollenweider and Kerekes, 1982), and range of values for Taylor River Pond

Trophic Level			**Total Phosphorus** *(*)* mg/l	**Chlorophyll *a*** mg/m^3	**Secci Depth** feet
Oligotrophic			<0.010	<2.5	>6
Mesotrophic			0.010 - 0.035	2.5 - 8	3 - 6
Eutrophic			>0.035	>8	<3
Taylor River Pond - Surface Water *(at a depth of 1 foot)*					
Sampling Events	OXY-01	7-May-08	0.024 - 0.032		>2.6 - 5.6
	OXY-02	24-Jun-08	0.033 - 0.068	1.7 - 9.5	>3.0 - 6.0
	OXY-03	22-Jul-08	0.035 - 0.048	3.1 - 6.9	
	OXY-04	31-Jul-08		2.0 - 4.7	>3.5 - 6.0
	OXY-05	7-Aug-08	0.044 - 0.051	5.3 - 17.0	3.5 - 6.0
	OXY-06	14-Aug-08			>2.5 - 6.0
	OXY-07	12-Sep-08	0.036 - 0.042	2.2 - 4.2	>2.0 - 6.5
	OXY-08	10-Oct-08	0.025 - 0.045		>2.0 - 6.0
Taylor River Pond - Surface Water at W-01 and W-6 *(at a depth of approximately 6-feet)*					
Sampling Events	OXY-01	7-May-08	0.028 - 0.030		
	OXY-02	24-Jun-08	0.030		
	OXY-03	22-Jul-08	0.035 - 0.067		
	OXY-04	31-Jul-08			
	OXY-05	7-Aug-08	0.049 - 0.052		
	OXY-06	14-Aug-08			
	OXY-07	12-Sep-08	0.035 - 0.160		
	OXY-08	10-Oct-08	0.067 - 0.080		

(*) Trophic levels for total phosphorus as defined by NHDES are as follows:

Oligotrophic	<0.010 mg/l
Mesotrophic	0.010 to 0.020 mg/l
Eutrophic	>0.020 mg/l

Table 18 – Taylor River
Numbers of River Herring Returning to Fishways on Coastal New Hampshire Rivers from 1972 – 2005

YEAR	COCHECO RIVER	EXETER RIVER	OYSTER RIVER	LAMPREY RIVER	TAYLOR RIVER	WINNICUT RIVER	ANNUAL TOTAL
1972				2,528		+	2,528
1973				1,380		+	1,380
1974				1,627		+	1,627
1975		2,639		2,882		+	5,521
1976	9,500		11,777	3,951	450,000	+	475,228
1977	29,500		359	11,256		2,700++	43,815
1978	1,925	205	419	20,461	168,256	3,229++	194,495
1979	586	186	496	23,747	375,302	3,410++	403,727
1980	7,713	2,516	2,921	26,512	205,420	4,393++	249,475
1981	6,559	15,626	5,099	50,226	94,060	2,316++	173,886
1982	4,129	542	6,563	66,189	126,182	2,500++	206,105
1983	968	1	8,866	54,546	151,100	+	215,481
1984	477		5,179	40,213	45,600	+	91,469
1985	974		4,116	54,365	108,201	+	167,656
1986	2,612	1,125	93,024	46,623	117,000	1,000++	261,384
1987	3,557	220	57,745	45,895	63,514	+	170,931
1988	3,915		73,866	31,897	30,297	+	139,975
1989	18,455		38,925	26,149	41,395	+	124,924
1990	31,697		154,588	25,457	27,210	+	238,952
1991	25,753	313	151,975	29,871	46,392	+	254,304
1992	72,491	537	157,024	16,511	49,108	+	295,671
1993	40,372	278	73,788	25,289	84,859	+	224,586
1994	33,140	*	91,974	14,119	42,164	+	181,397
1995	79,385	592	82,895	15,904	14,757	+	193,533
1996	32,767	248	82,362	11,200	10,113	+	136,690
1997	31,182	1,302	57,920	22,236	20,420	+	133,060
1998	25,277	392	85,116	15,947	11,979	219	138,930
1999	16,679	2,821	88,063	20,067	25,197	305	153,132
2000	30,938	533	70,873	25,678	44,010	525	172,557
2001	46,590	6,703	66,989	39,330	7,065	1,118	167,795
2002	62,472	3,341	58,179	58,605	5,829	7,041	195,467
2003	71,199	71	51,536	64,486	1,397	5,427	194,116
2004	47,934	83	52,934	66,333	1,055	8,044	176,383
2005	16,446	66	12,882	40,026	223	2,703	72,346

Source: NHFG Annual Progress Report, 2005, Anadromous Fish Investigations

* - Due to damage to the fish trap, fishway became a swim through operation.
+ - Fishway unable to pass fish until modifications in 1997.
++ - Fish netted below and hand passed over Winnicut River dam.

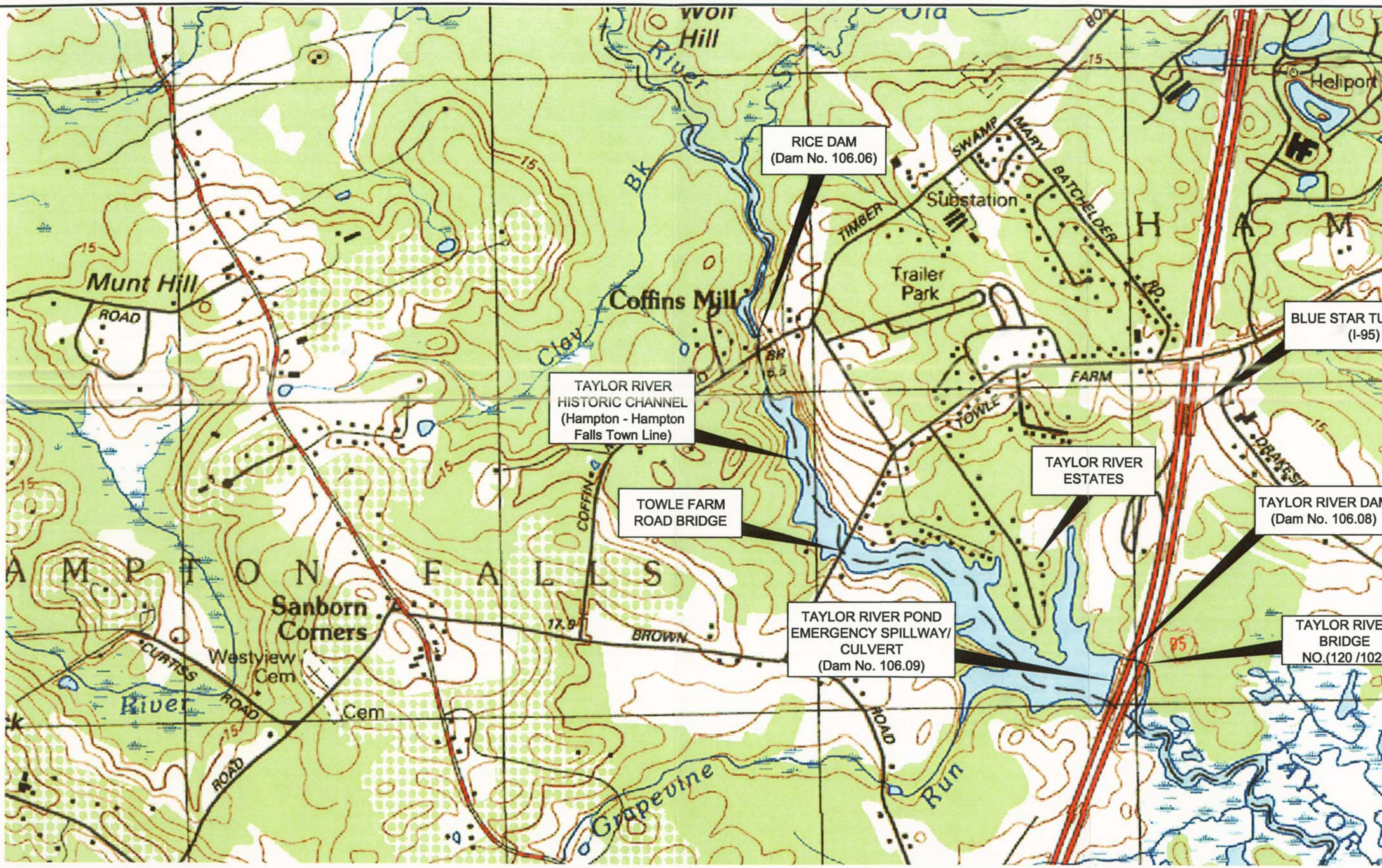
Table 19
Results of Fish Sampling by NH Fish and Game Department in Taylor River Pond, April through June, 2007

Sample date	RH	ECP	LMB	BC	BG	RBS	PMK	BBH	GS	UNK	SNT
4/25/07*		14	21								
5/10/07	4	14			1			1	3		
5/11/07	1	4			1			2	1		
5/15/07	9	2	1				3		1		
5/16/07		1			1	2					
5/17/07	11						1		1		
5/18/07	No	Fish									
5/30/07		3		1			1	2			
5/31/07		3	1					1			
6/1/07		5	1						3		
6/2/07		1					4				
6/3/07									2		
6/4/07		2			1						
6/5/07	1	3	1								
6/6/07		7									
6/7/07	1	1					1				
6/8/07		1					1	1	1		
6/9/07	1	2									
6/10/07		1			3		1	2			
6/11/07		1			1		1	1			
6/12/07				1				1		2	1
6/14/07			1				2				
6/16/07		4			1		1	1			1
6/17/07		2									
6/18/07	No	Fish									
6/20/07							1				
6/21/07		1			1		2				
6/22/07					1						
6/23/07				1			5				
6/25/07		1		1				4	1		
Total	28	73	26	4	11	2	24	16	13	2	2
%	14.1	36.7	13.1	2.0	5.5	1.0	12.1	8.0	6.5	1.0	NA

- Sampling was by electrofishing on 4/25/07. Gill nets were used on all other sample dates.

Key: RH = river herring; ECP = eastern chain pickerel; LMB = largemouth bass; BC = black crappie; BG = bluegill; RBS = redbreast sunfish; PMK = pumpkinseed; BBH = brown bullhead; GS = golden shiner; UNK = unknown fish species; SNT = snapping turtle

FIGURES



NOTES:

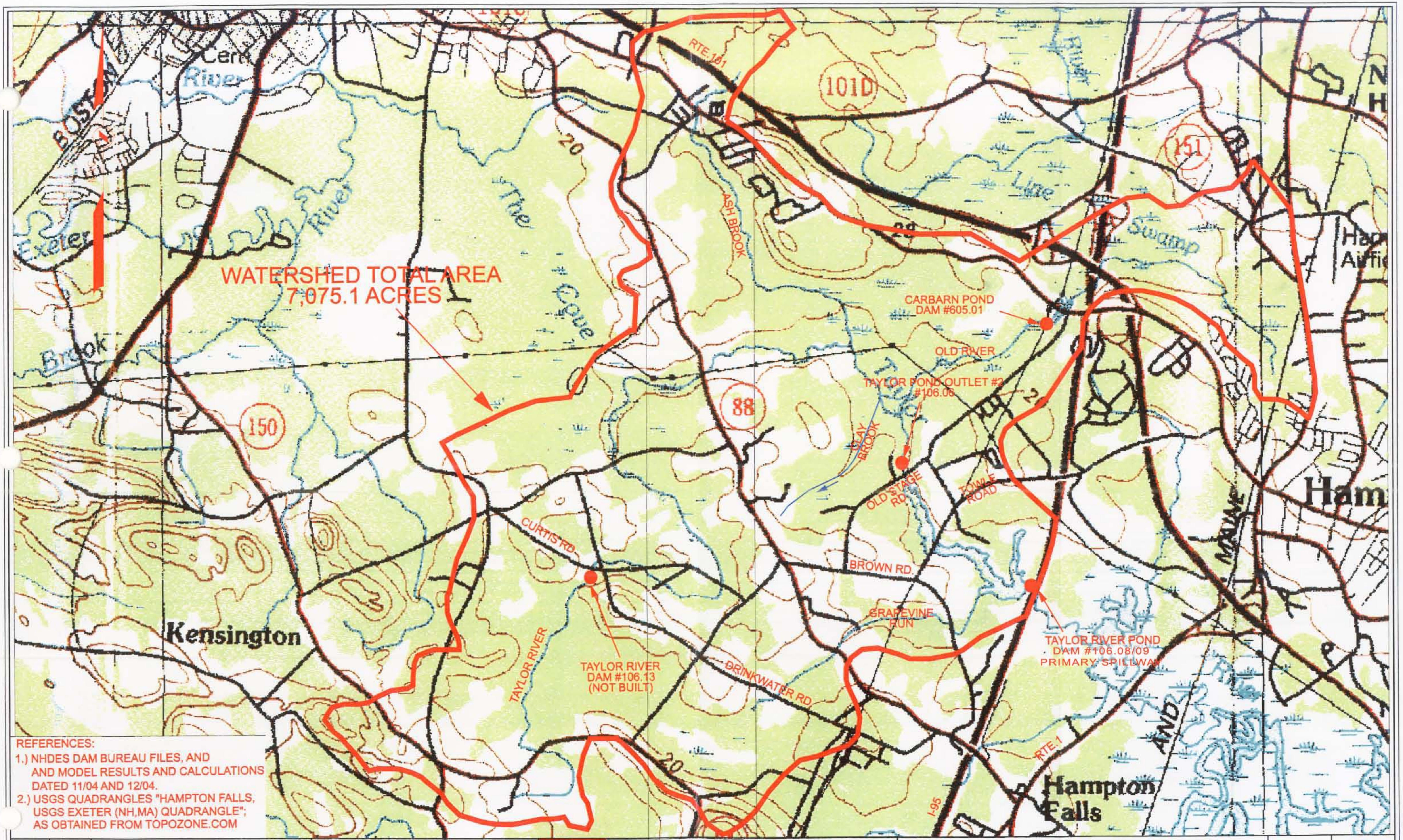
1. BASE MAP IS FROM THE EXETER, NH QUADRANGLE, 1992, CONTOUR INTERVAL 3 METERS, PROVIDED BY MAPTECH, TERRAIN NAVIGATOR.

0 1000 2000

APPROXIMATE SCALE, FEET

Replacement of I-95 Bridge (No. 120 /102) over Taylor River Dam Hampton and Hampton Falls, New Hampshire The Louis Berger Group Manchester, New Hampshire	THE Louis Berger Group, INC. 1001 Elm Street, Suite 203 Manchester, New Hampshire 03101 Tel 603 644 5200 Fax 603 644 5220 www.Louisberger.com June 2010	SITE VICINITY MAP FIGURE 1

PLOTTED: 07/23 :34AM BY:EDHIMA
LAST SAVED: 07/23/09 11:30AM BY:EDHIMA
DRAWING: V:\1586_TAYLOR RIVER\CAD\GRAPHS FOR REPORT 7-22-09\FIG 1.DWG [FEASIBILITY STUDY]



NUMBER	DATE	REVISION

1/4 0 1/4 1/2
SCALE IN MILES

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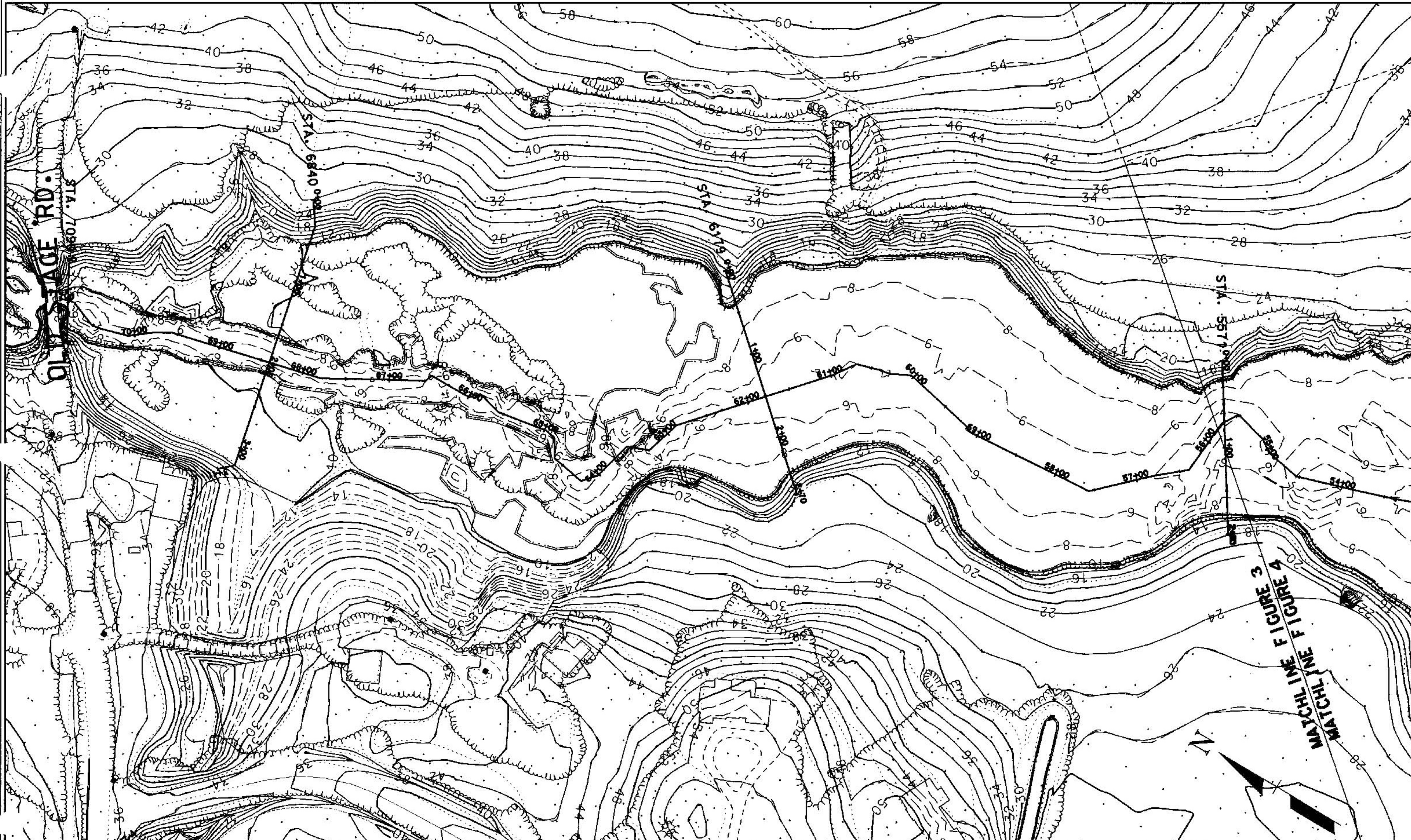
TAYLOR RIVER DAM
WATERSHED AREA
HAMPTON FALLS-HAMPTON, NH

DATE June 2010
JOB No CM 1586
FIGURE No 2



NUMBER	DATE	REVISION

50 0 50 100
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REPLACEMENT OF I-95 BRIDGE (No. 120/102) OVER TAYLOR RIVER

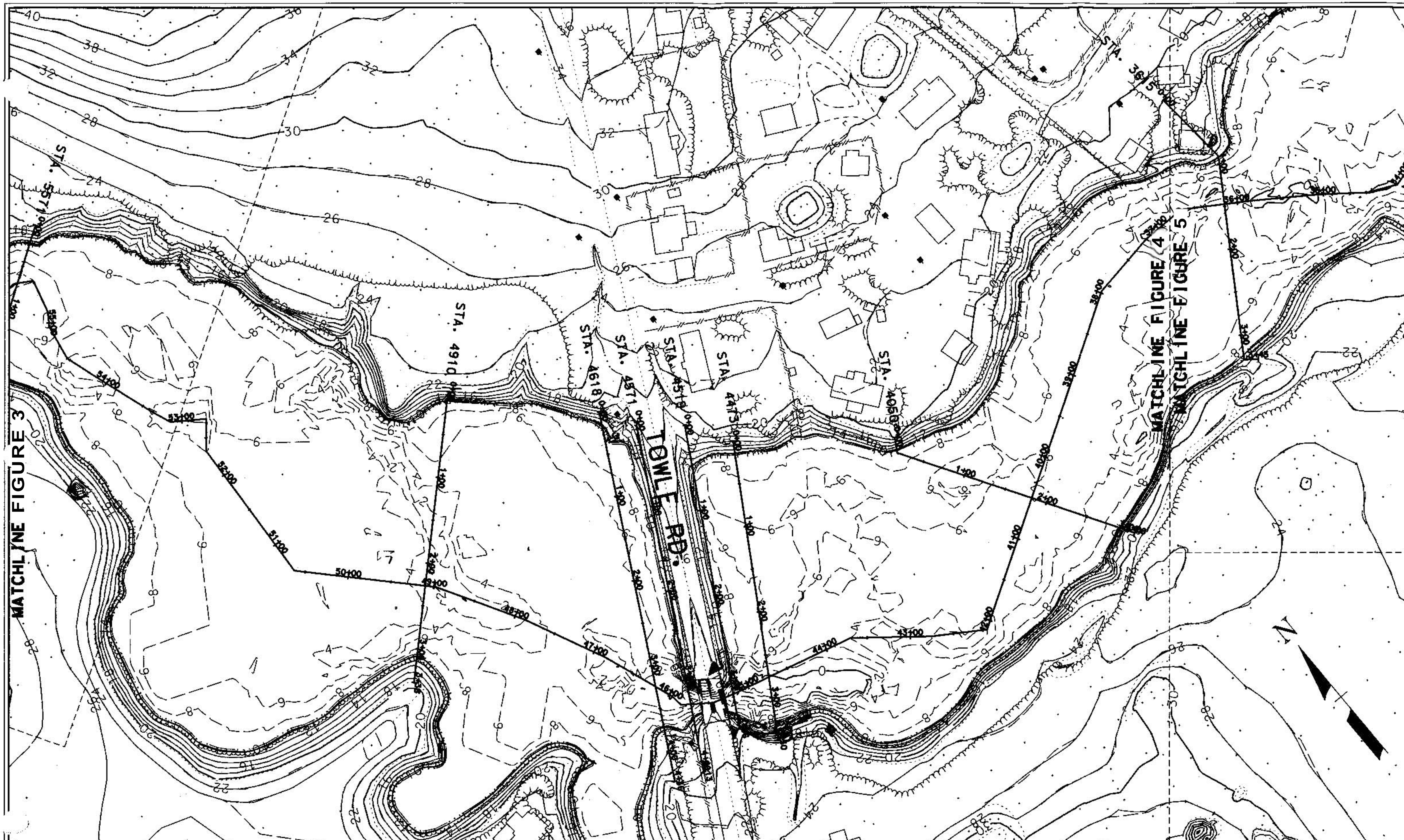
HYDRAULIC MODEL CROSS SECTIONS

HAMPTON FALLS-HAMPTON, NH

DATE: June 2010

JOB No: CM 1586

FIGURE: 3



NUMBER	DATE	REVISION

50 0 50 100
SCALE IN FEET

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REPLACEMENT OF I-95 BRIDGE (No.120/102)
OVER TAYLOR RIVER
HYDRAULIC MODEL CROSS SECTIONS
HAMPTON FALLS-HAMPTON, NH

DATE June 2010
JOB No CM 1586
FIGURE 4

NUMBER	DATE	REVISION

50 0 50 100
SCALE IN FEET

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REPLACEMENT OF I-95 BRIDGE (No. 120/102)
OVER TAYLOR RIVER

HYDRAULIC MODEL CROSS SECTIONS
HAMPTON FALLS-HAMPTON, NH

DATE: June 2010
JOB No: CH 1586
FIGURE No: 5

NUMBER	DATE	REVISION

50 0 50 100
SCALE IN FEET

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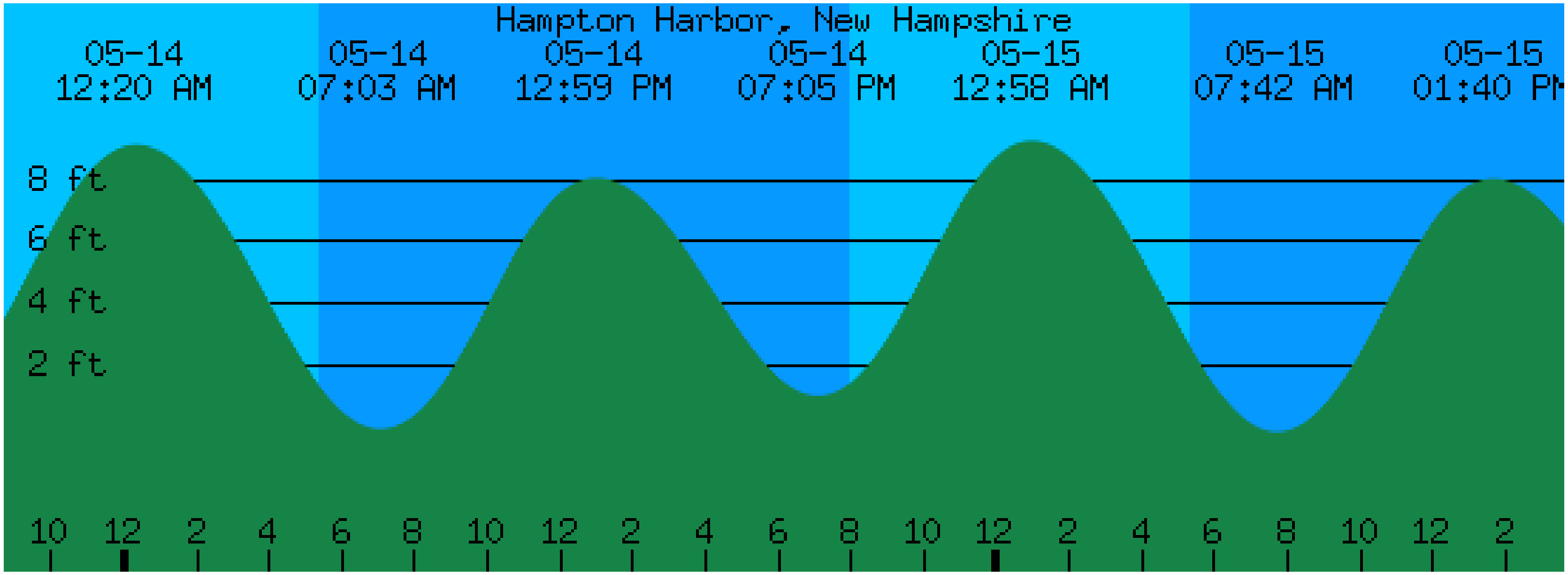
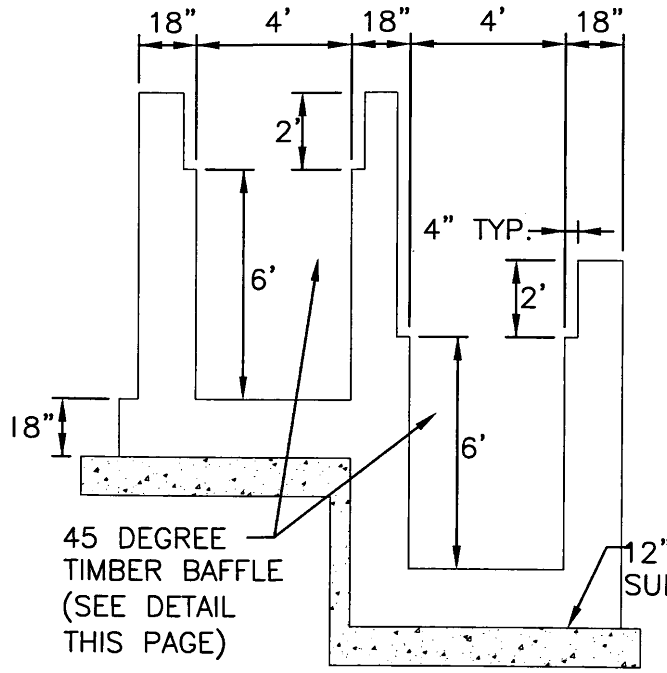
REPLACEMENT OF I-95 BRIDGE (No. 120/102
OVER TAYLOR RIVER
HYDRAULIC MODEL CROSS SECTIONS
HAMPTON FALLS-HAMPTON, NH

DATE: June 2010
JOB No: CM 1586
FIGURE 6

Figure 7: Taylor River
Tides at Hampton Harbor, NH

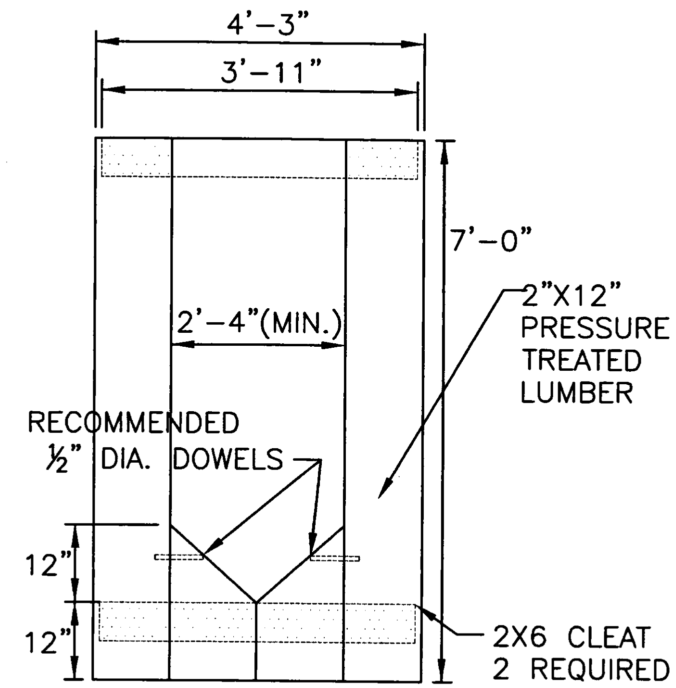


(Source: http://zen.surfline.com/cgi-bin/tidepredictor.pl)



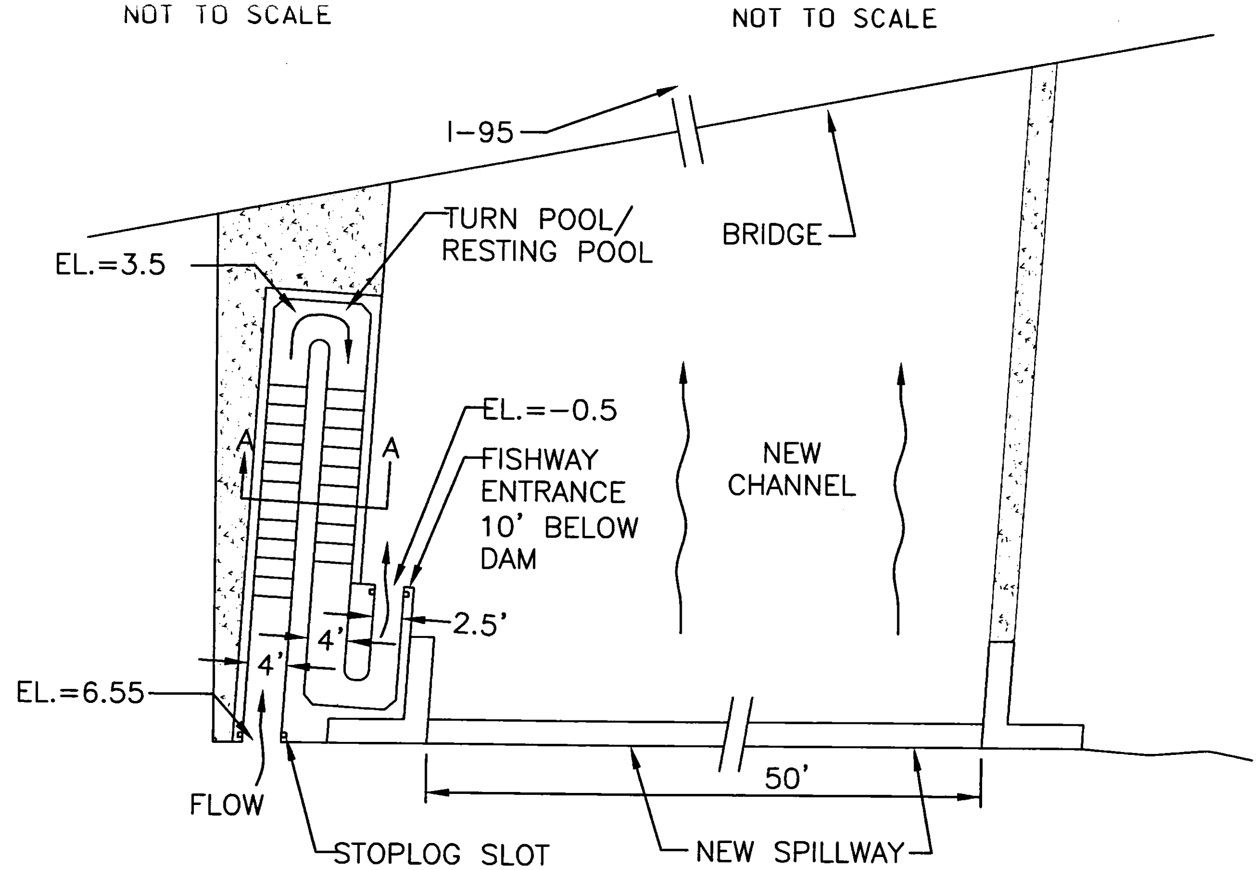
SECTION A-A

NOT TO SCALE



TIMBER BAFFLE DETAIL

NOT TO SCALE



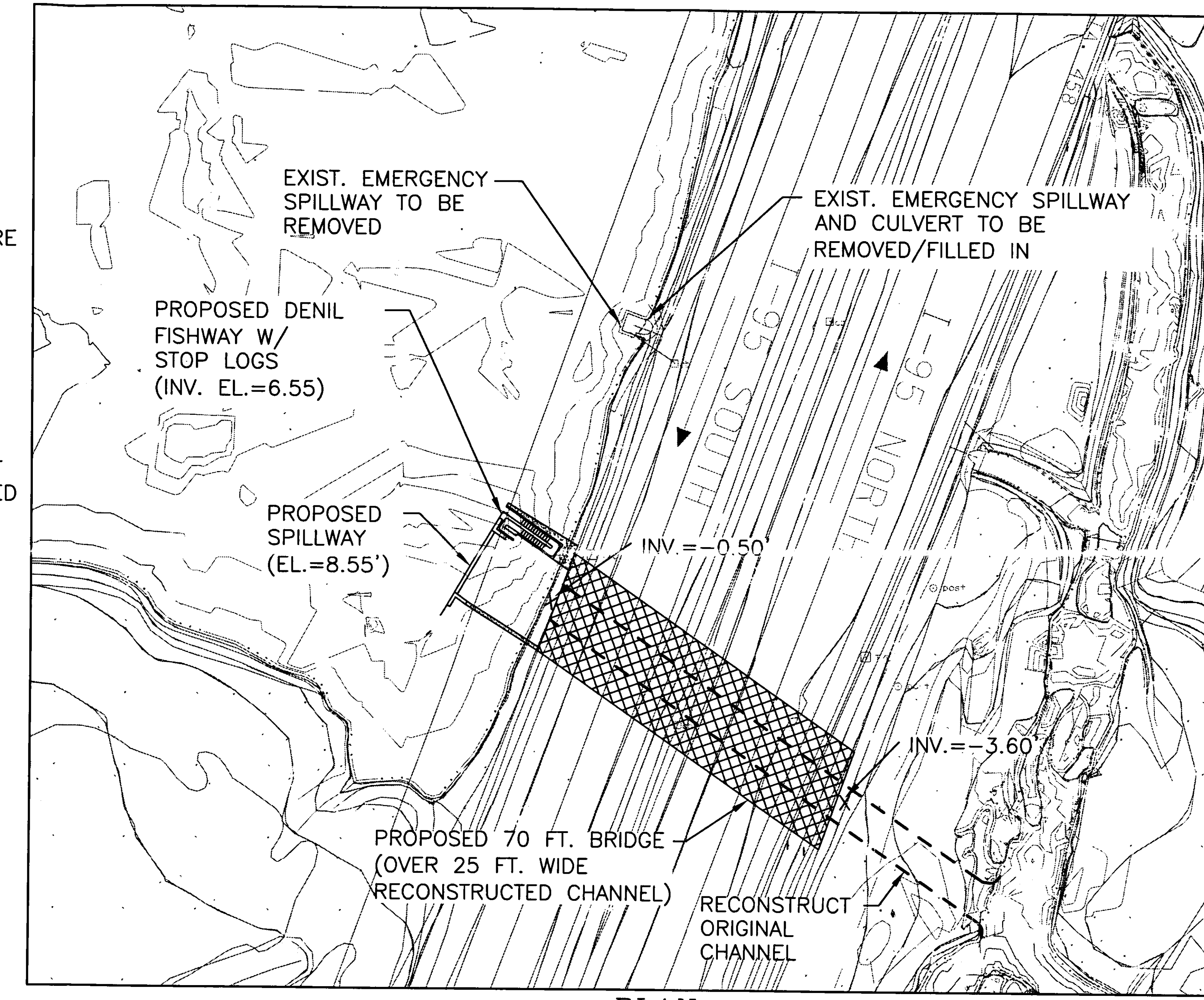
DENIL FISHWAY
- 2.5FT WIDE-DOWNSTREAM ENTRANCE
- SLOPE OF 1:6
- SPACE BETWEEN BAFFLES-30"
- WATER DEPTH IN FISHWAY: 2FT-4FT

TAYLOR POND

WSEL ELEV. = 8.55'

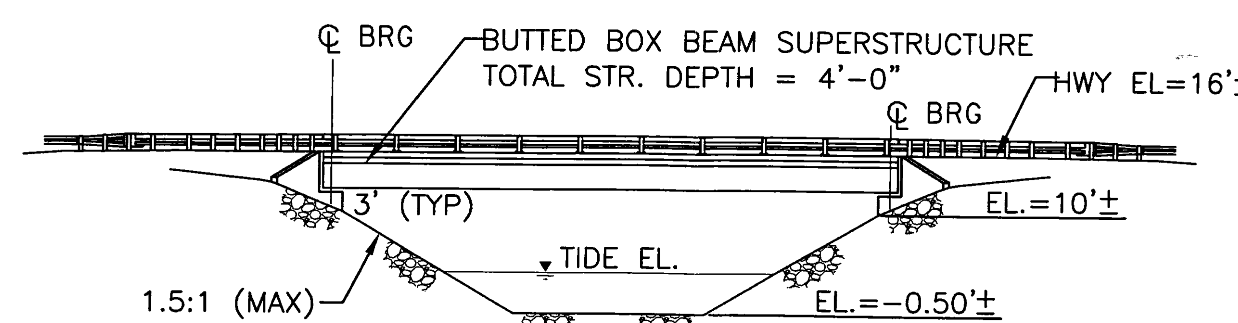
FISHWAY DETAIL

NOT TO SCALE



PLAN

1"=100'



BRIDGE ELEVATION

1"=20'

NUMBER	DATE	REVISION

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Fax 603 644 5220
www.Louisberger.com

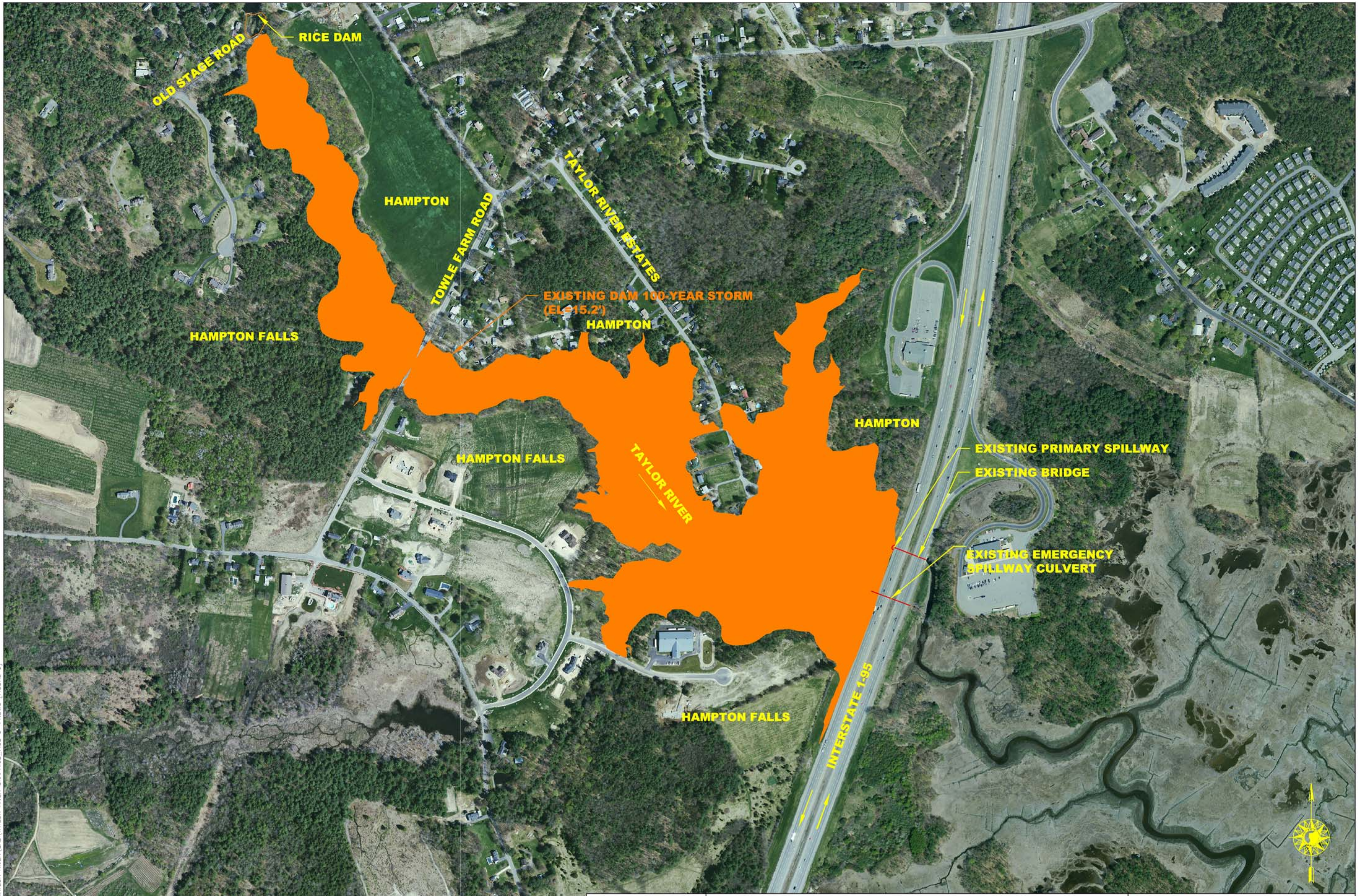
REPLACEMENT OF I-95 BRIDGE (NO.120/102)
OVER TAYLOR RIVER
PROPOSED BRIDGE / SPILLWAY & FISHWAY SCHEMATIC
HAMPTON FALLS-HAMPTON, NH

DATE June 2010

JOB No CM 1586

FIGURE 8

DRAWING: V:\1586_TAY… RIVER\CAD\PROPOSED BRIDGE - DAM SCHEMATIC.DWG [PROPOSED BRIDGE_DAM]



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TAYLOR RIVER HAMPTON FALLS-HAMPTON

FIGURE 9 ALTERNATIVE A
EXISTING BRIDGE AND SPILLWAYS - NO ACTION

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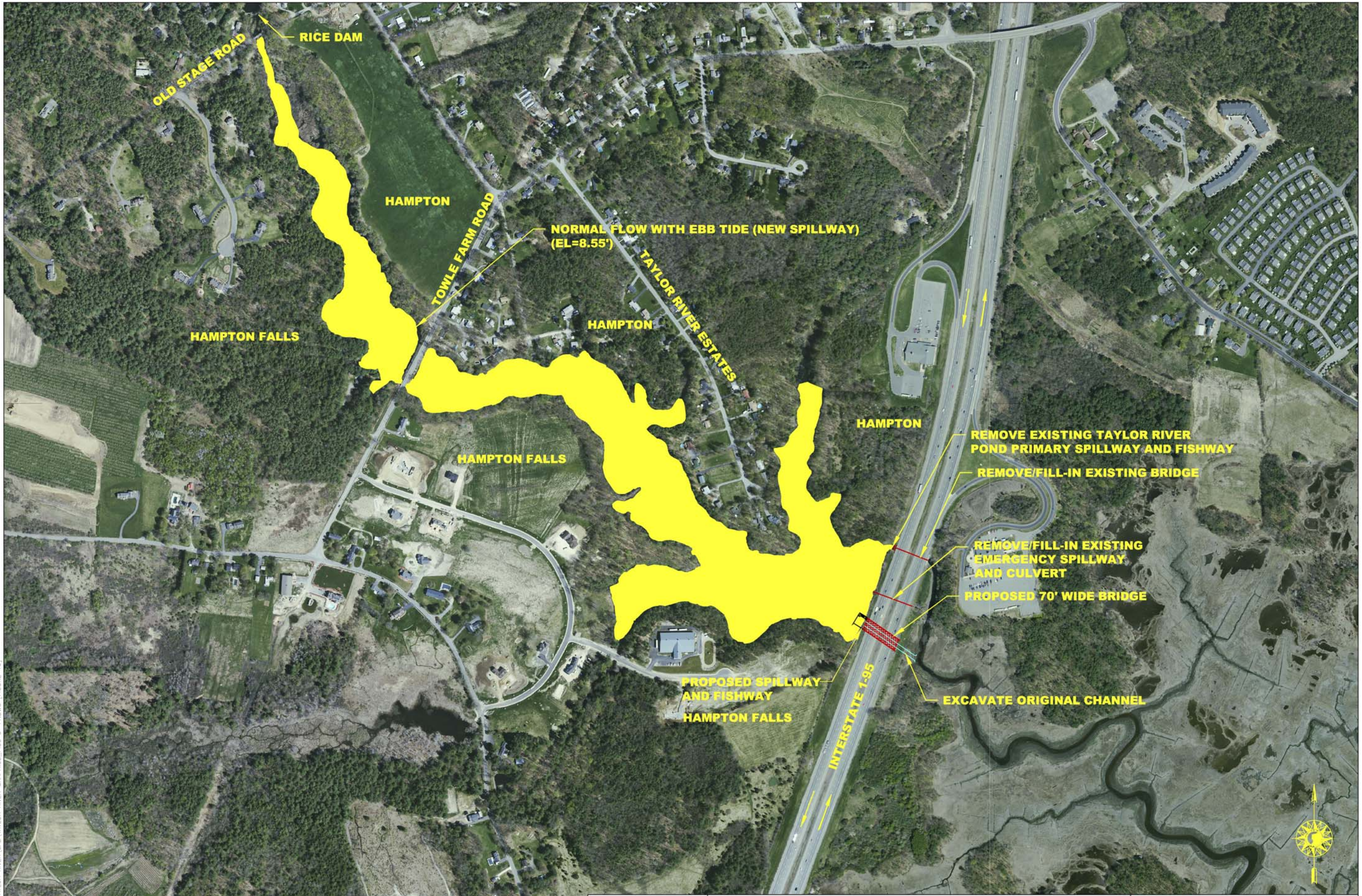
DRAWING: V:\1586_TAYLOR RIVER\CAD\TAYLOR RIVER GRAPHICS_FIGS 9-11.DWG [FIGURE 9]



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Scale in Feet

TAYLOR RIVER HAMPTON FALLS-HAMPTON

FIG. 10 ALT. B NEW BRIDGE, SPILLWAY AND FISHWAY
WITH NORMAL FLOW AND EBB TIDE

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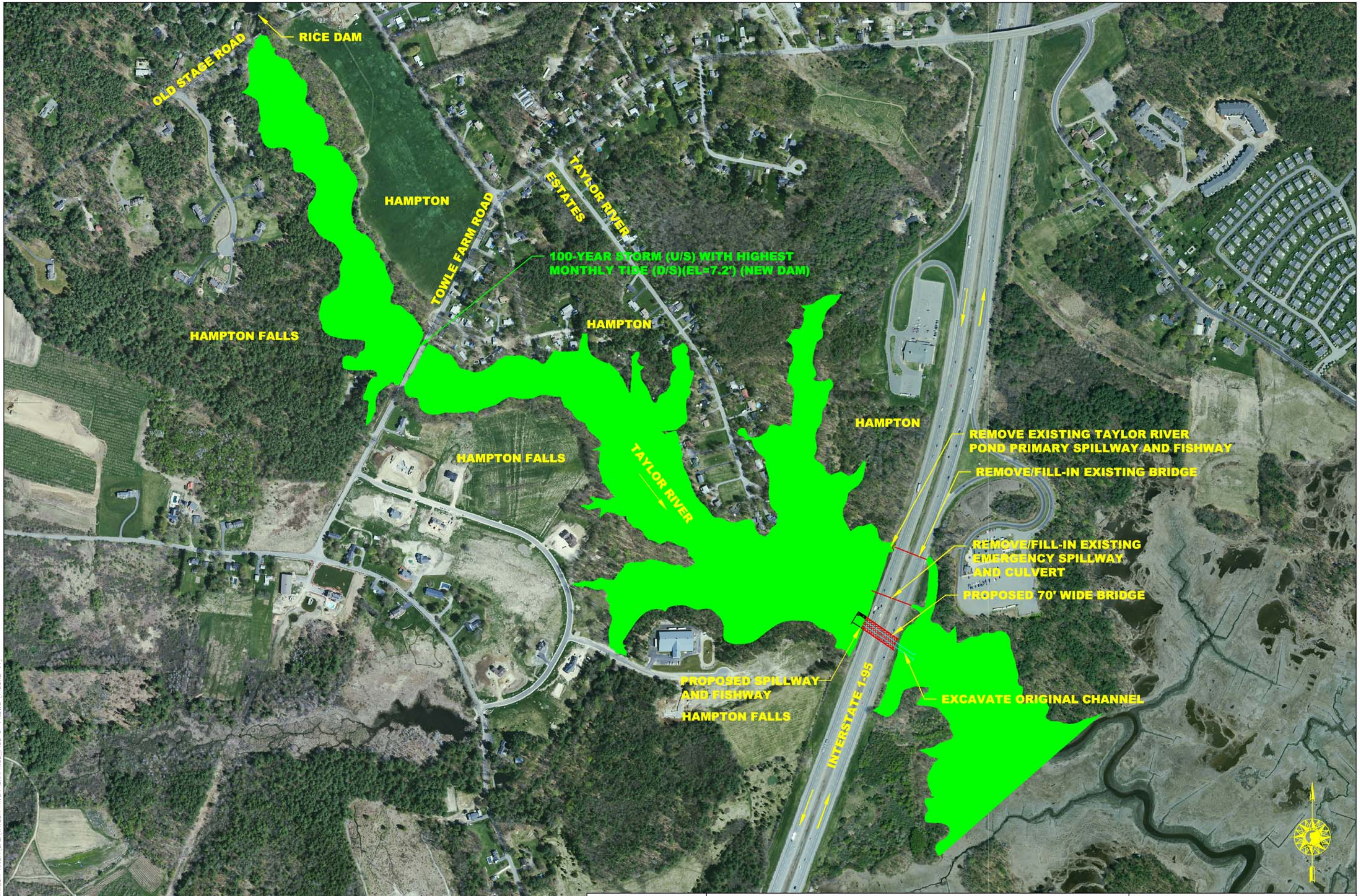

June 2010

200 0 100 200 400
Scale in Feet

TAYLOR RIVER HAMPTON FALLS-HAMPTON
FIG. 11 ALT. B - NEW BRIDGE, SPILLWAY AND FISHWAY
100-YEAR STORM (U/S) WITH HIGHEST MONTHLY TIDE (D/S)

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DRAWING: V:\1586_TAYLOR RIVER\CAD\TAYLOR RIVER GRAPHICS_FIGS 9-11.DWG [FIGURE 11]

June 2010

200 0 100 200 400
Scale In Feet

TAYLOR RIVER HAMPTON FALLS-HAMPTON
FIG. 12 ALT. C - NEW BRIDGE WITHOUT SPILLWAY
NORMAL FLOW AT EBB TIDE

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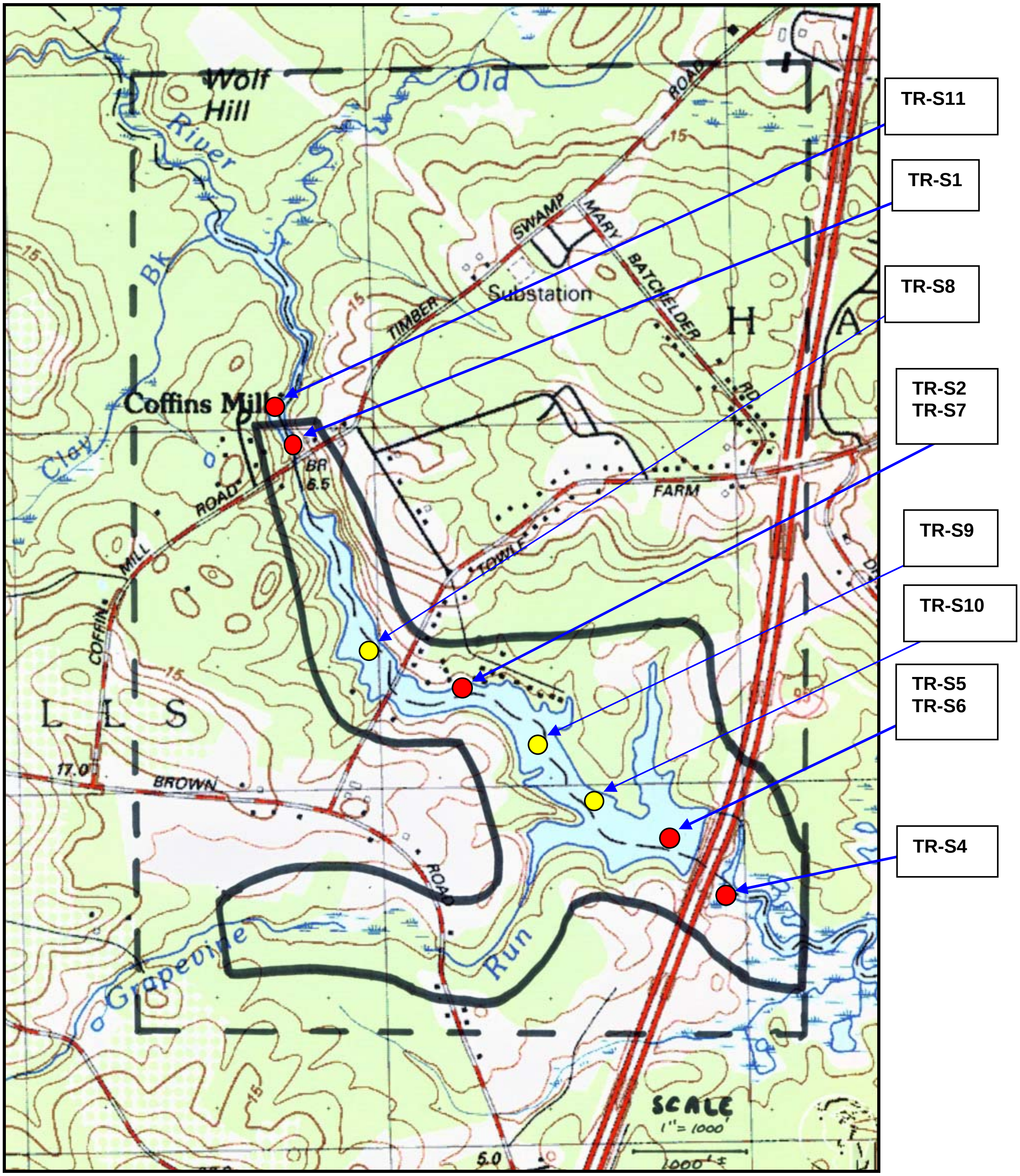


Figure 13: Taylor River Pond Dam Impoundment Sediment Sampling Stations

[Yellow dots indicate stations for only grain size analyses. Red dots indicate stations with grain size and chemistry analyses.]

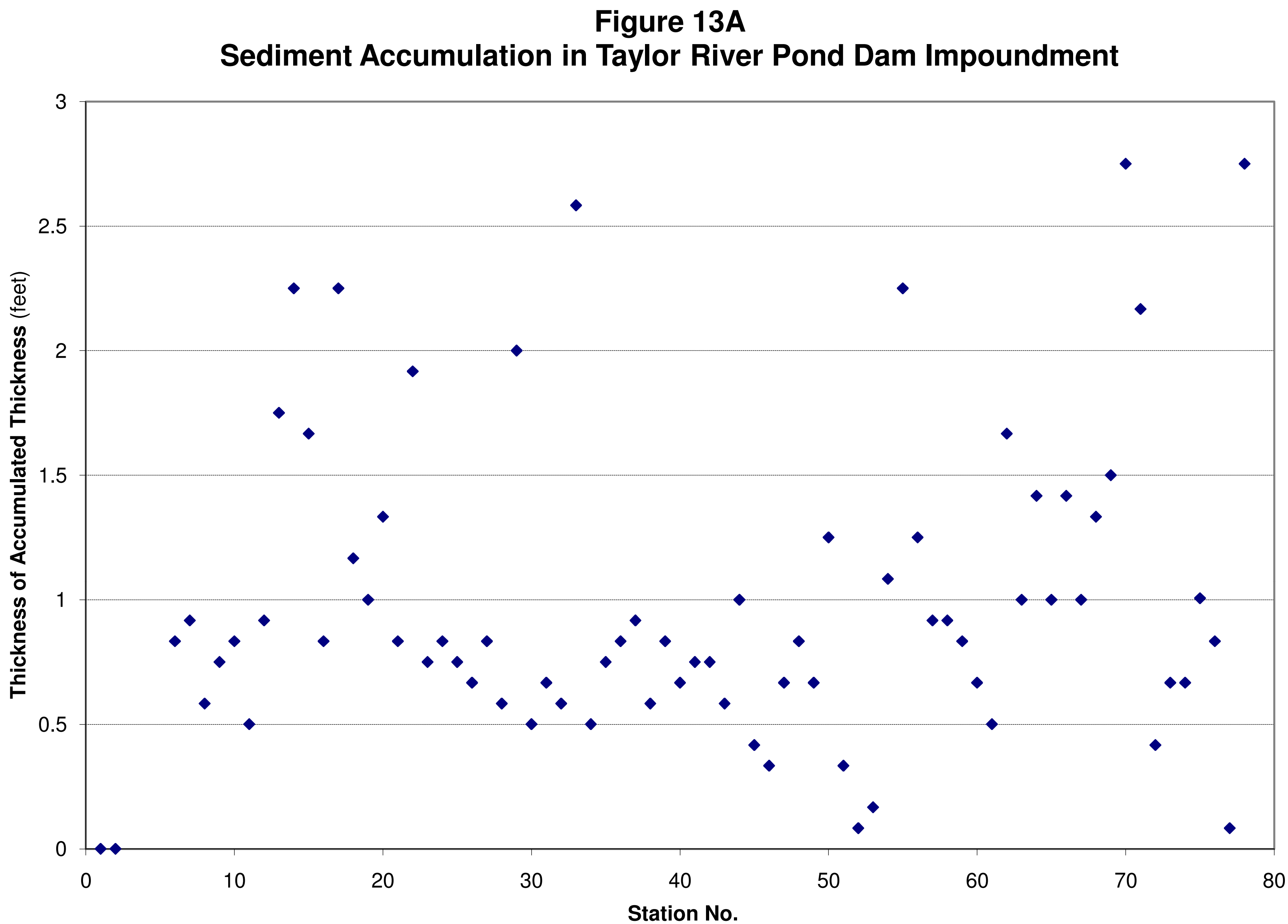
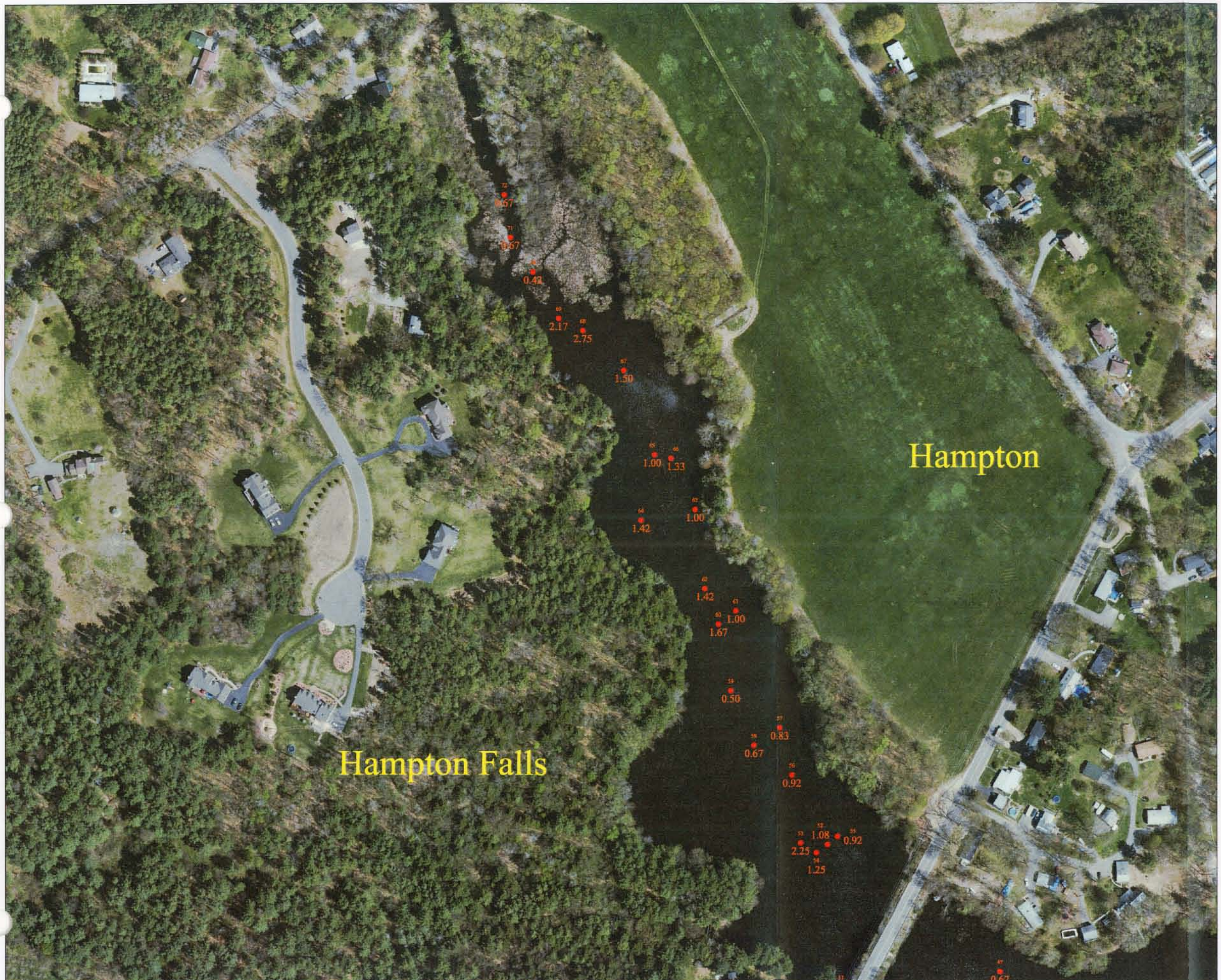


Figure13A_Sediment Accumulation.xlsxSediment Thickn.



LEGEND

● Sample Location

ID Number

1.33 Thickness of Sediment (feet)

50 0 50 100

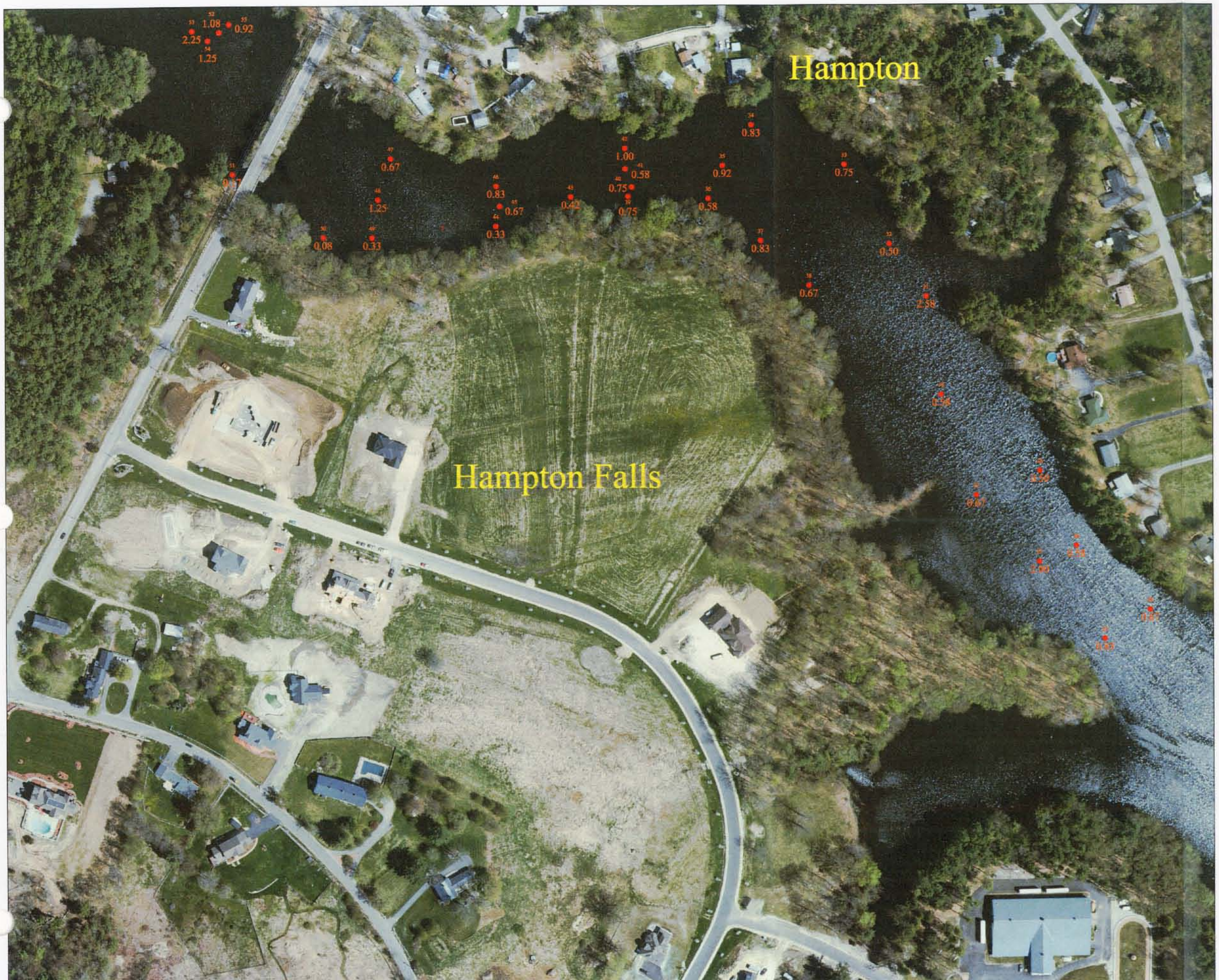
SCALE IN FEET

FIGURE 14

Thickness of Accumulated Sediment
Taylor River Pond
10-23-07

The Louis Berger Group Inc.

...\nhoitt\dms20751\WRKIIM0001.dgn 10/23/2007 4:40:17 PM nhoitt"



LEGEND

● Sample Location

ID Number

1.33 Thickness of Sediment (feet)

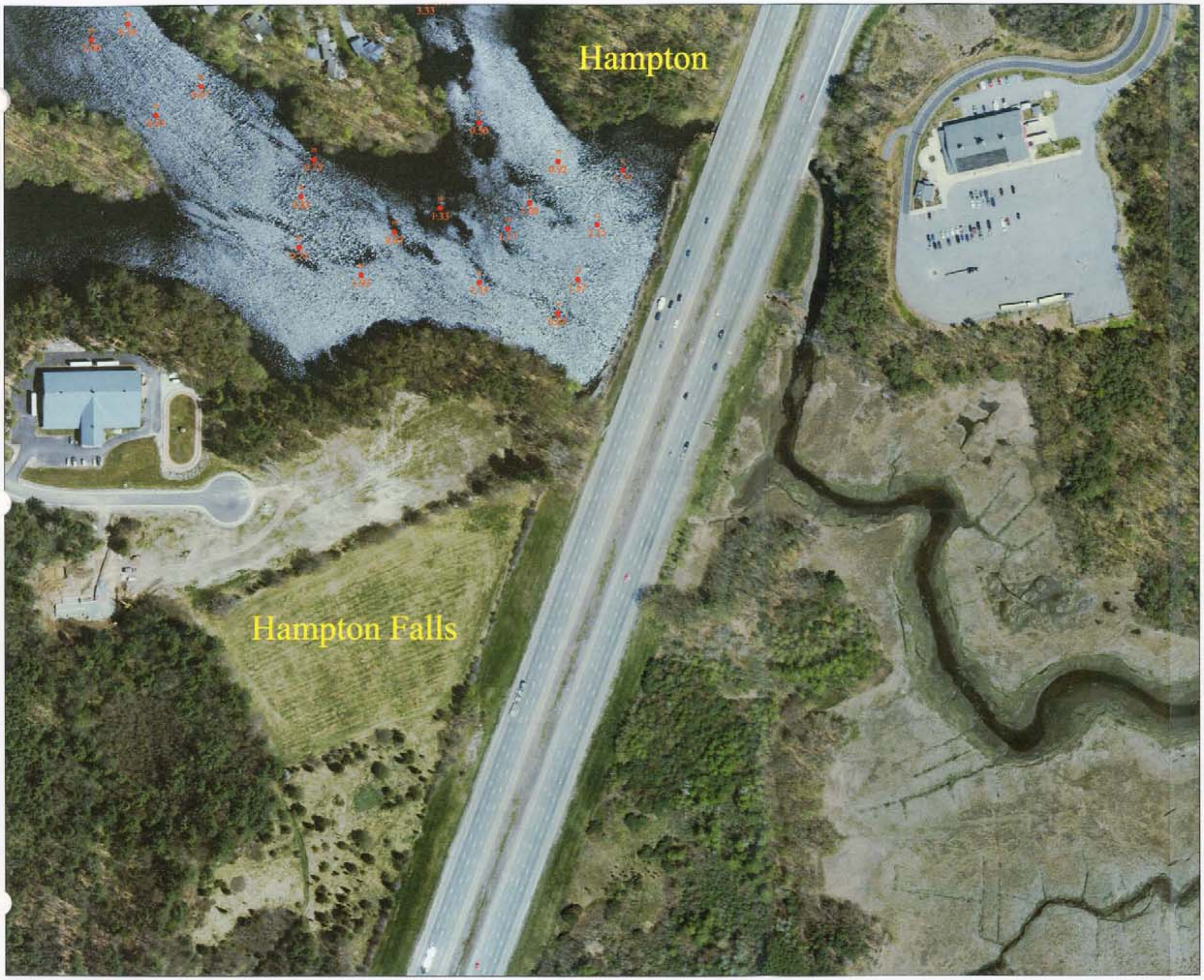
50 0 50 100

SCALE IN FEET

FIGURE 15

Thickness of Accumulated Sediment
Taylor River Pond
10-23-07

The Louis Berger Group Inc.



LEGEND

- ● Sample Location
- ID Number
- 1.33 Thickness of Sediment (feet)

50 0 50 100
SCALE IN FEET

FIGURE 16

Thickness of Accumulated Sediment
Taylor River Pond
10-23-07

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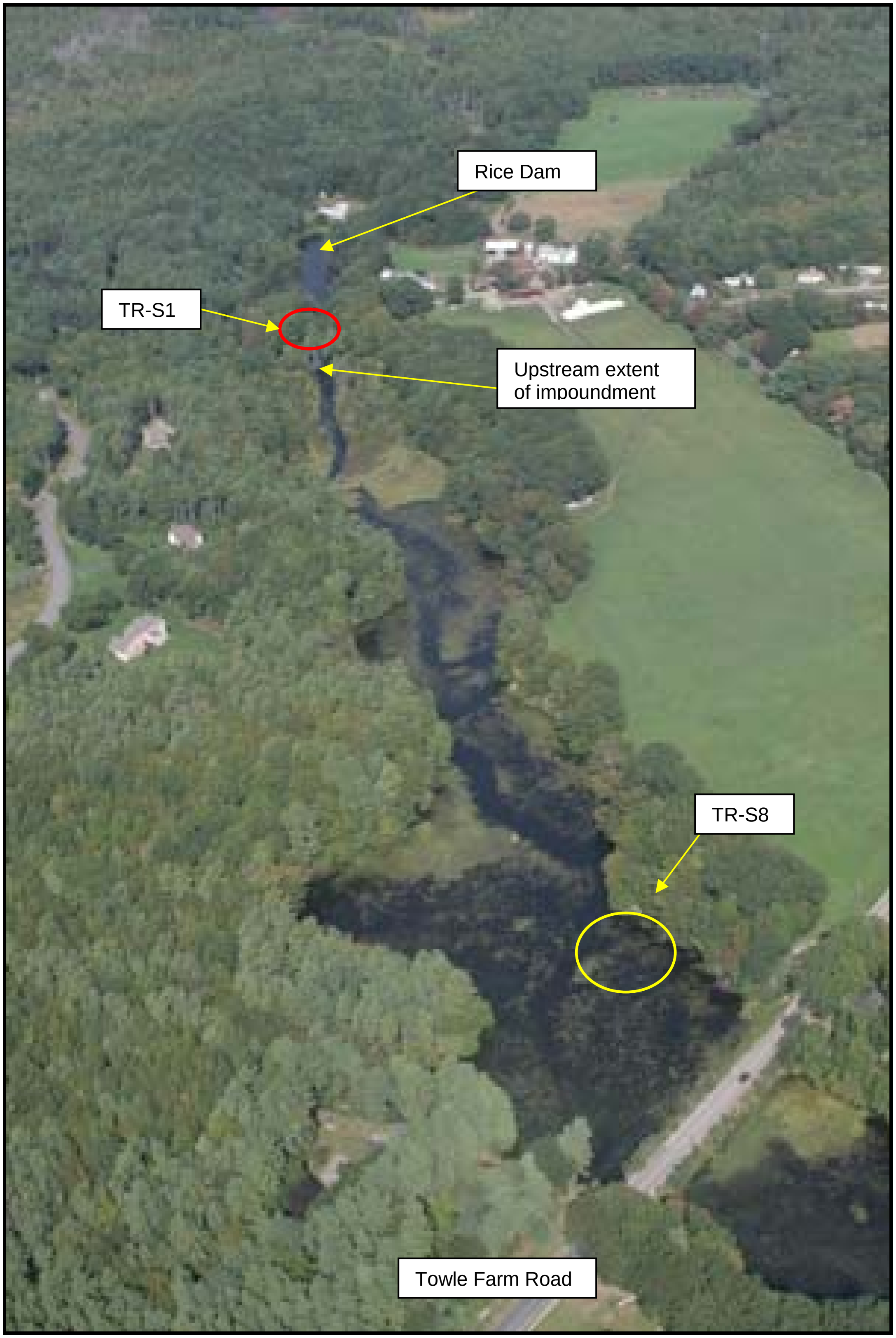


Figure 17: Upper Taylor River Pond Dam Impoundment Stations TR-S1 (chemistry) and TR-S8 (grain size only)

Figure 18: Sediment Sampling Station TR-S1 Location (View 1)
[Looking to the northwest from Old Stage Road bridge. Three subsamples were collected: 1 of 3 (right side), 2 of 2 (center), and 3 of 3 (left). Rice Dam is in the background.]

Figure 19: Sediment Sampling Station TR-S1 Location (View 2)
[Looking west from the northern shore. The three subsamples are again marked: 1 of 3 (foreground), 2 of 2 (center), and 3 of 3 (background).]

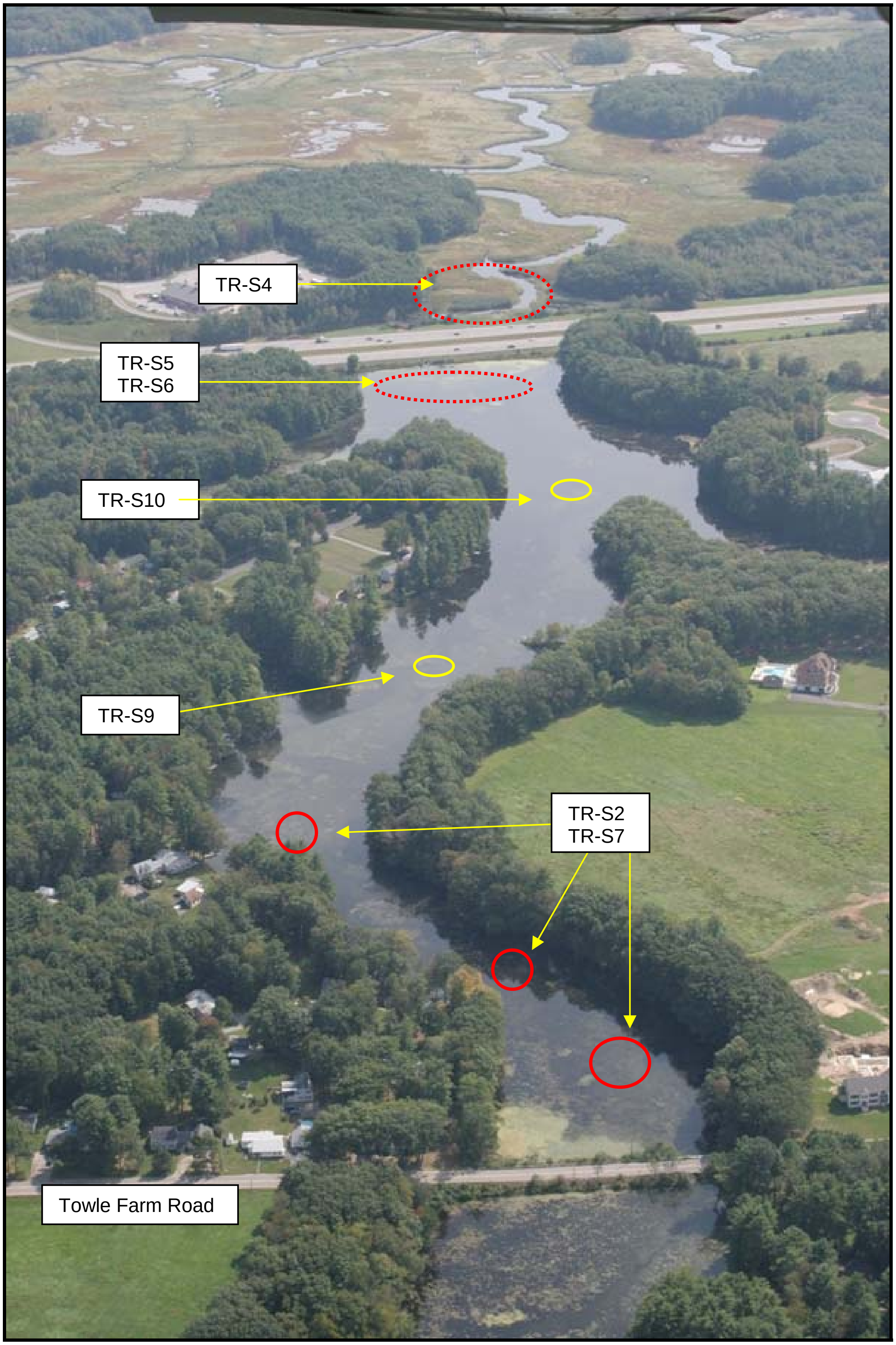


Figure 20: Mid-Section of the Taylor River Pond Dam Impoundment - TR-S2 and TR-S7 Sediment Sampling Sub-Sample Locations

[Additional grain size stations were TR-S9 and TR-S10.]

Figure 21: Sediment Sample Taken from TR-S2 (Sub-Sample 3 of 3)

[Fine-grained sediment collected from the upper 7 inches at Station TR-S2.]

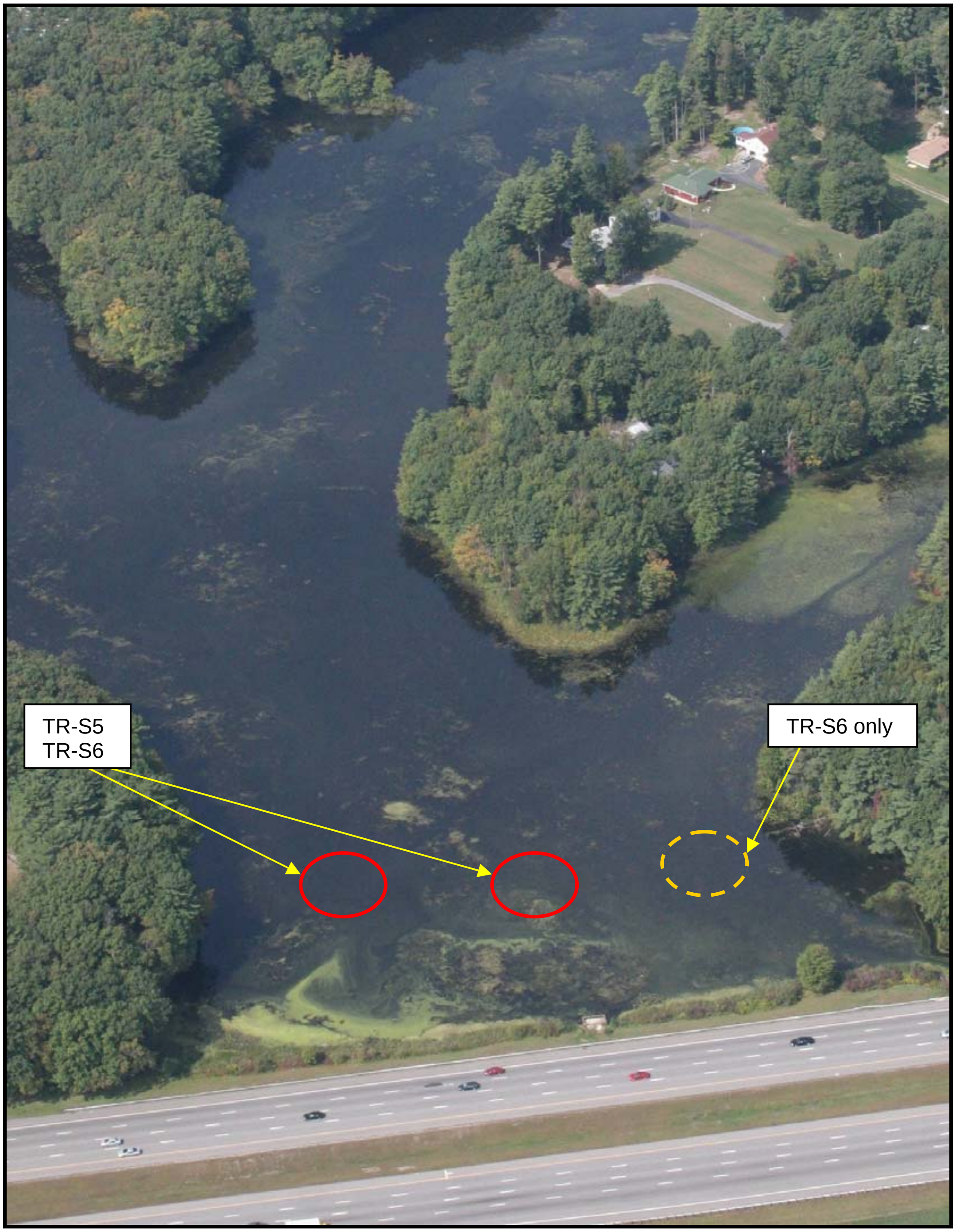


Figure 22: Lower Taylor River Pond Dam Impoundment Sediment Sampling Location TR-S5 and TR-S6

[Sample TR-S5 consisted of two composited sub-samples. Sample TR-S6 consisted of three composited sub-samples.]

Figure 23: Sediment Sample Taken from Station TR-S5 (Sub-Sample 1 of 2)

[Fine-grained sediment collected from the upper 7 inches at Station TR-S5. The sediment contained hardly any vegetation such as roots.]

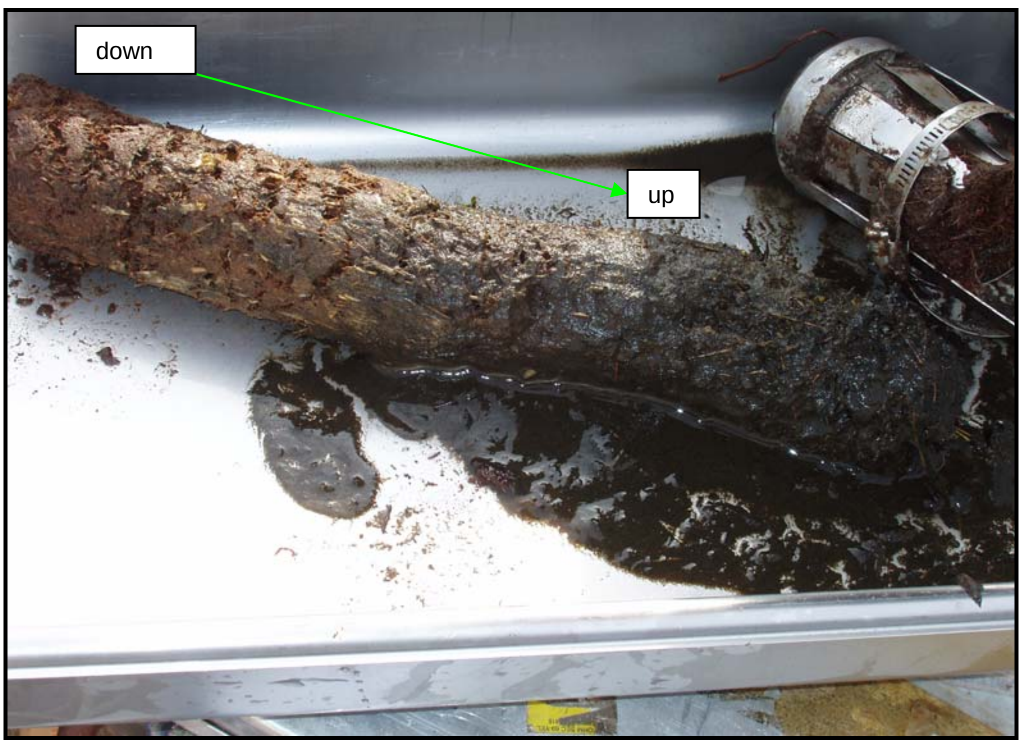


Figure 24: Sediment core at Station TR-S5

[Collected by core from underneath the upper fine-grained sediment layer. The sediment contained a high density of vegetation and likely represents the pre-impoundment marsh surface.]

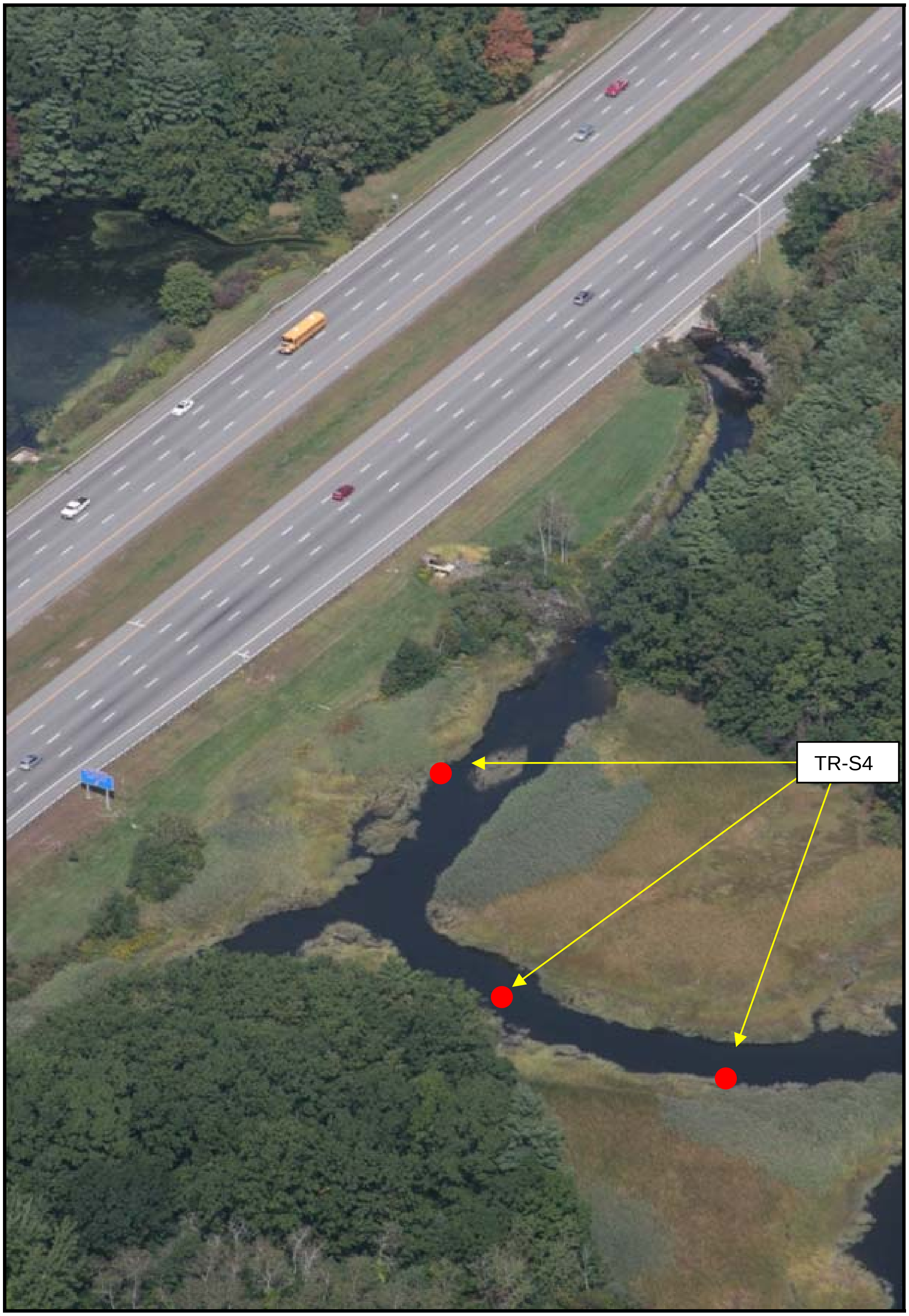


Figure 25: Sediment Sampling Station TR-S4 and Sub-Sampling Locations

[Along the estuary downstream of the Taylor River impoundment. The subsample on the left was located 6 feet to the south of the station of the salinity meter deployment. Samples were collected from the inter-tidal zone at low tide.]

Figure 26: Sediment Sampling Station TR-S4 (Sub-Sample 2 of 3)
[View 1 - Looking to the west.]

Figure 27: Sediment Sampling Station TR-S4 (Sub-Sample 2 of 3)
[View 2 - looking to the east.]

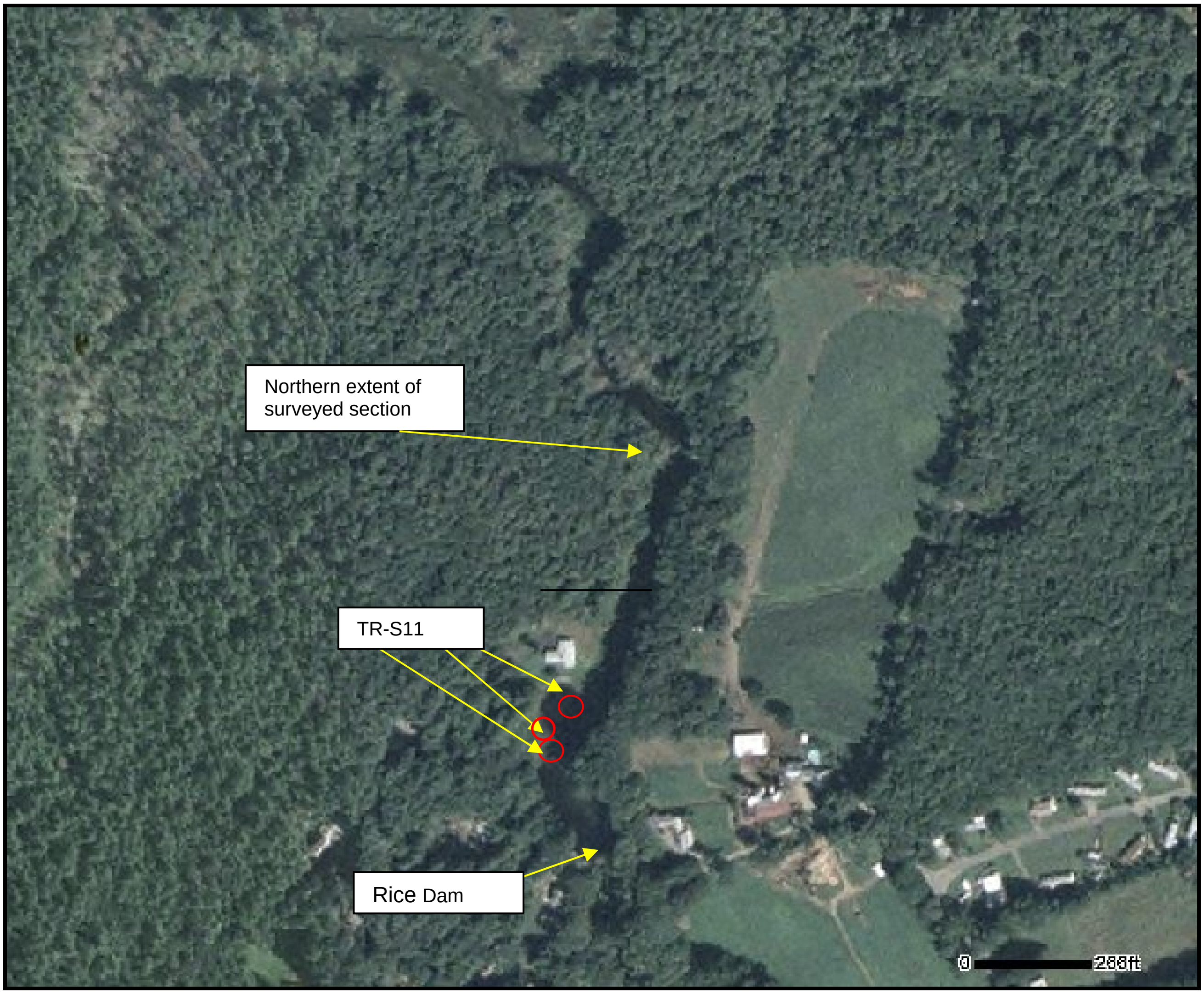


Figure 28: Rice Dam Impoundment and Sediment Sampling Station TR-S11 Location

[Two sub-samples were collected in the vicinity of the southern circle; one sub-sample was collected from the northern circle.]

Figure 29 - Gill net and electrofishing boat fish sampling areas for public and wildlife risk assessment sampling in the Taylor River Pond in 2007, Hampton-Hampton Falls, NH.

* *The area designating gill net sets only indicate general area of positioning and not true positions.*

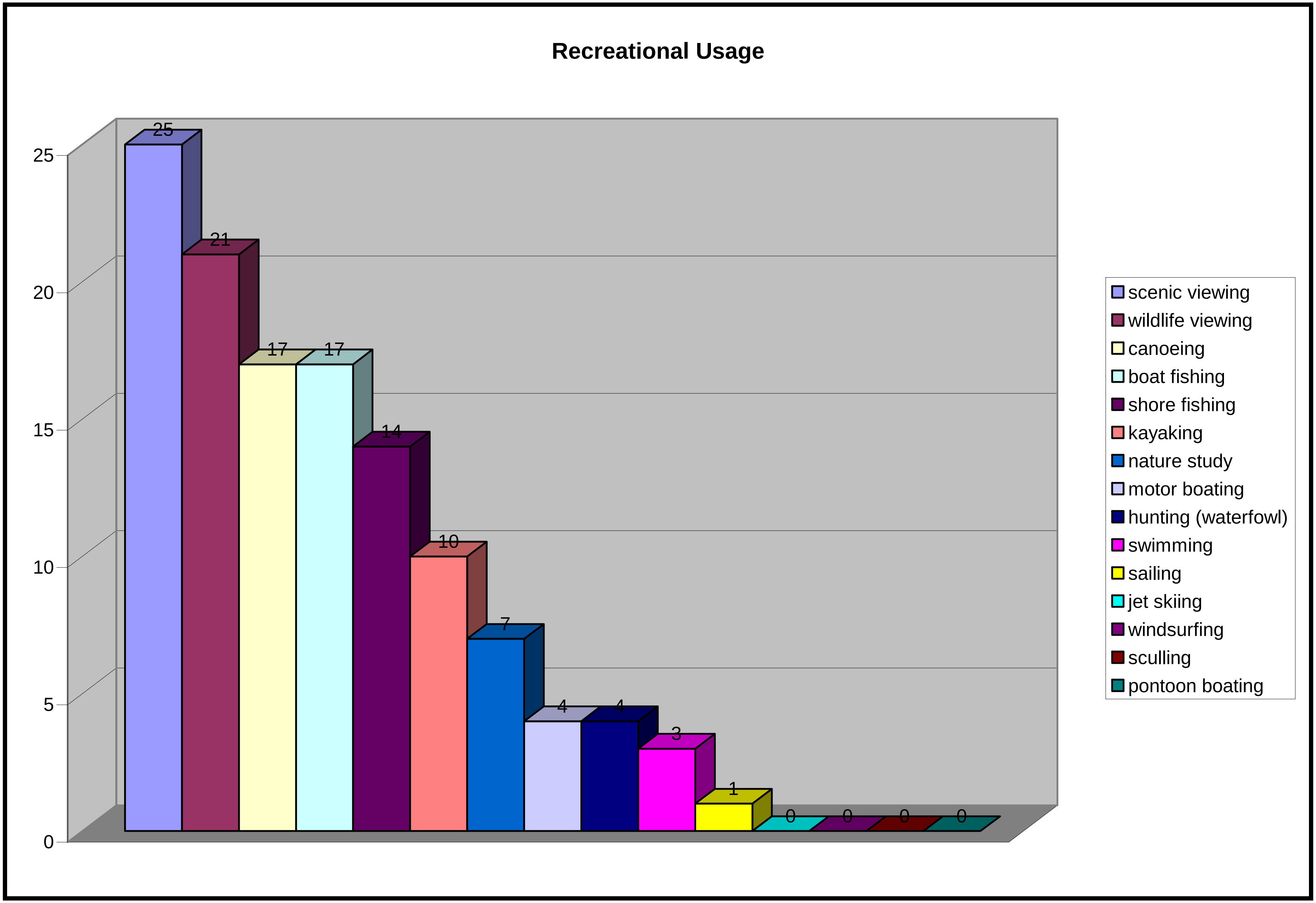


Figure 30 - Types of Recreational Uses within the Taylor River Pond and Number of Respondents

Figure 31 - Dissolved Oxygen Concentration Statistics for the Taylor River
August 31 - September 5, 2006, NHDES VRAP

Figure 32: Vertical dissolved oxygen concentrations profiles at Station W-06. This station was located in the lower third of the Taylor River Pond, just upstream of the confluence with the Grapevine Run.

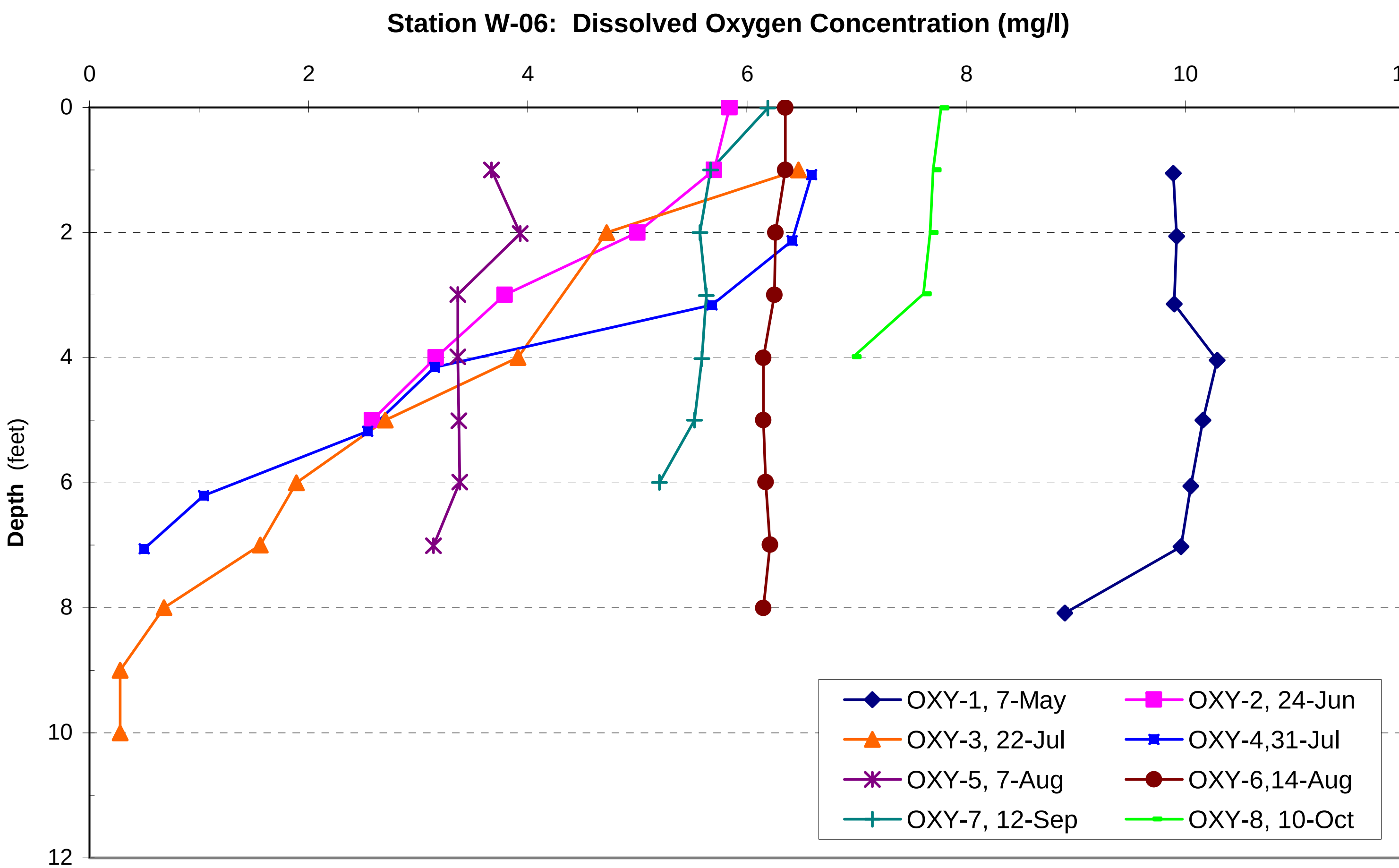


Figure 33: Taylor River Pond - Continuous dissolved oxygen concentration and temperature at Station W-06.

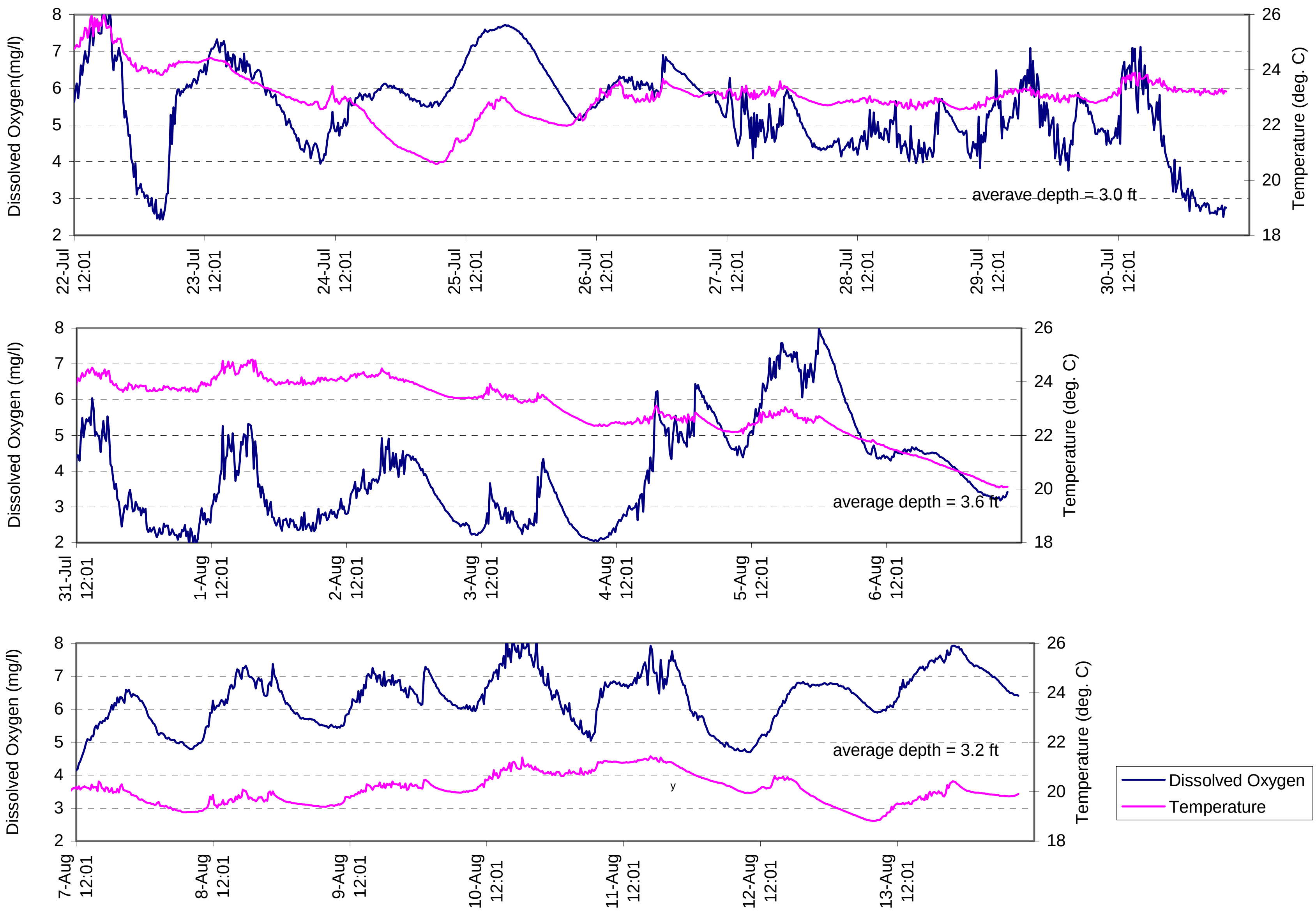
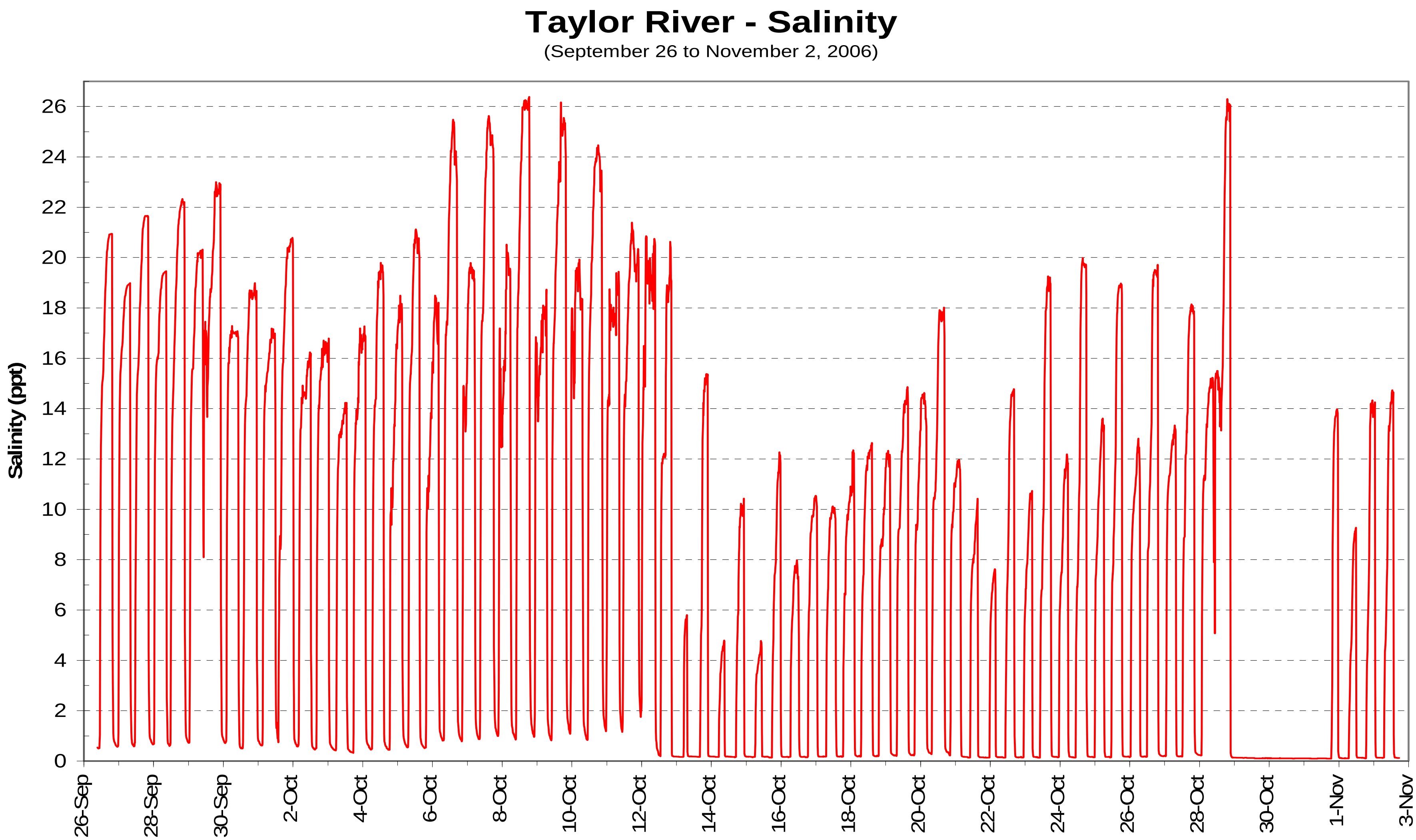
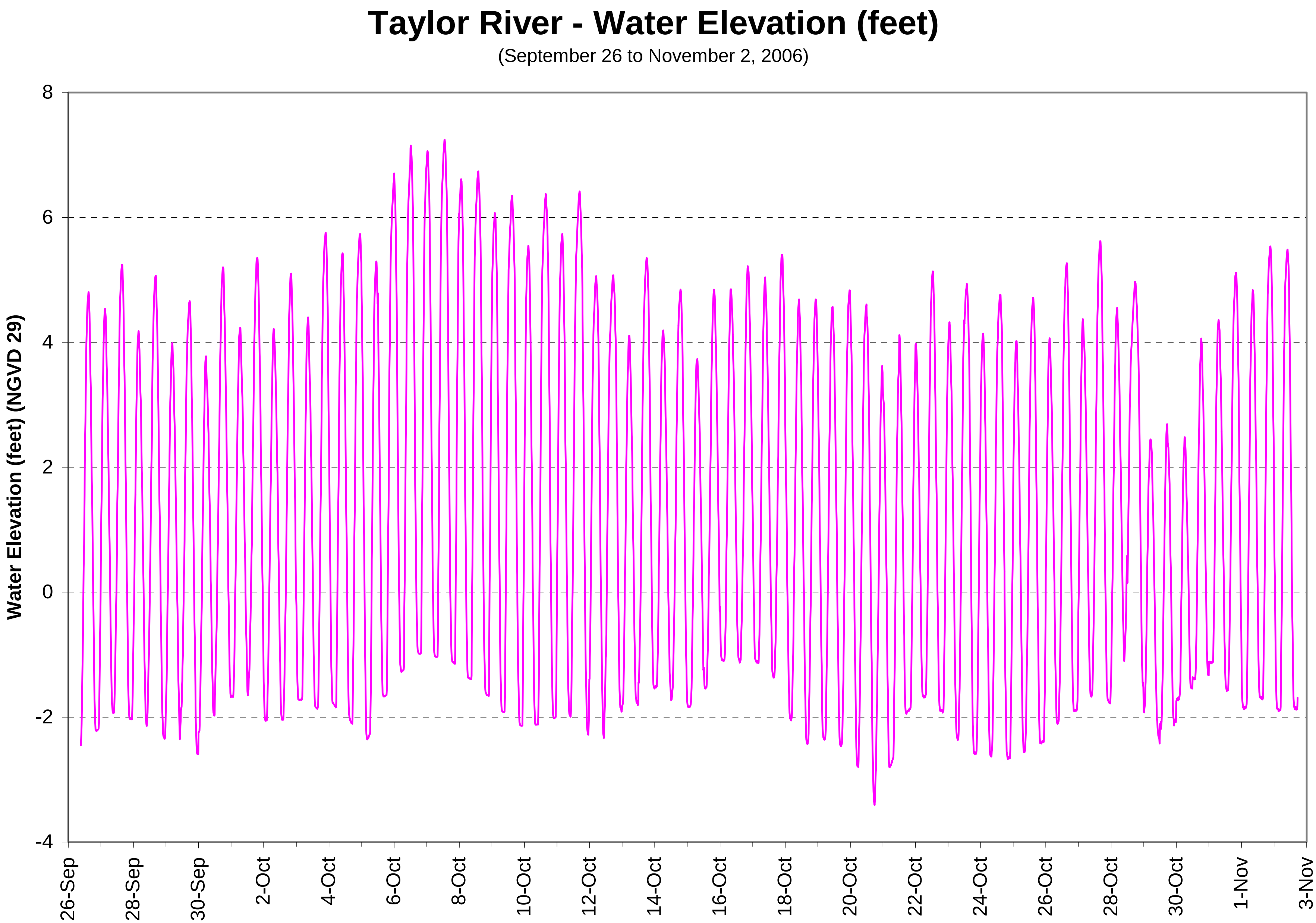


Figure 34



Taylor River - Salinity
(September 26 to November 2, 2006)
Salinity (ppt)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
26-Sep
28-Sep
30-Sep
2-Oct
4-Oct
6-Oct
8-Oct
10-Oct
12-Oct
14-Oct
16-Oct
18-Oct
20-Oct
22-Oct
24-Oct
26-Oct
28-Oct
30-Oct
1-Nov
3-Nov

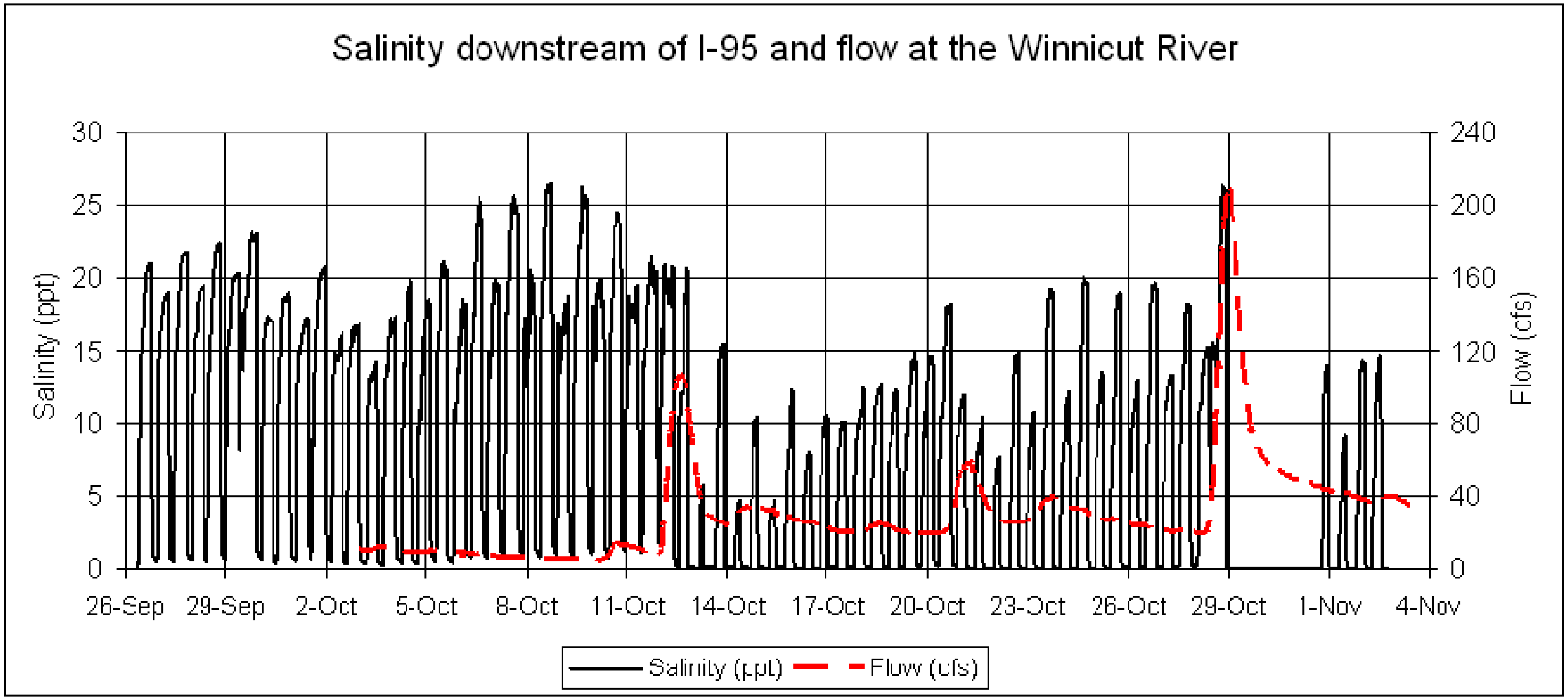
Figure 35

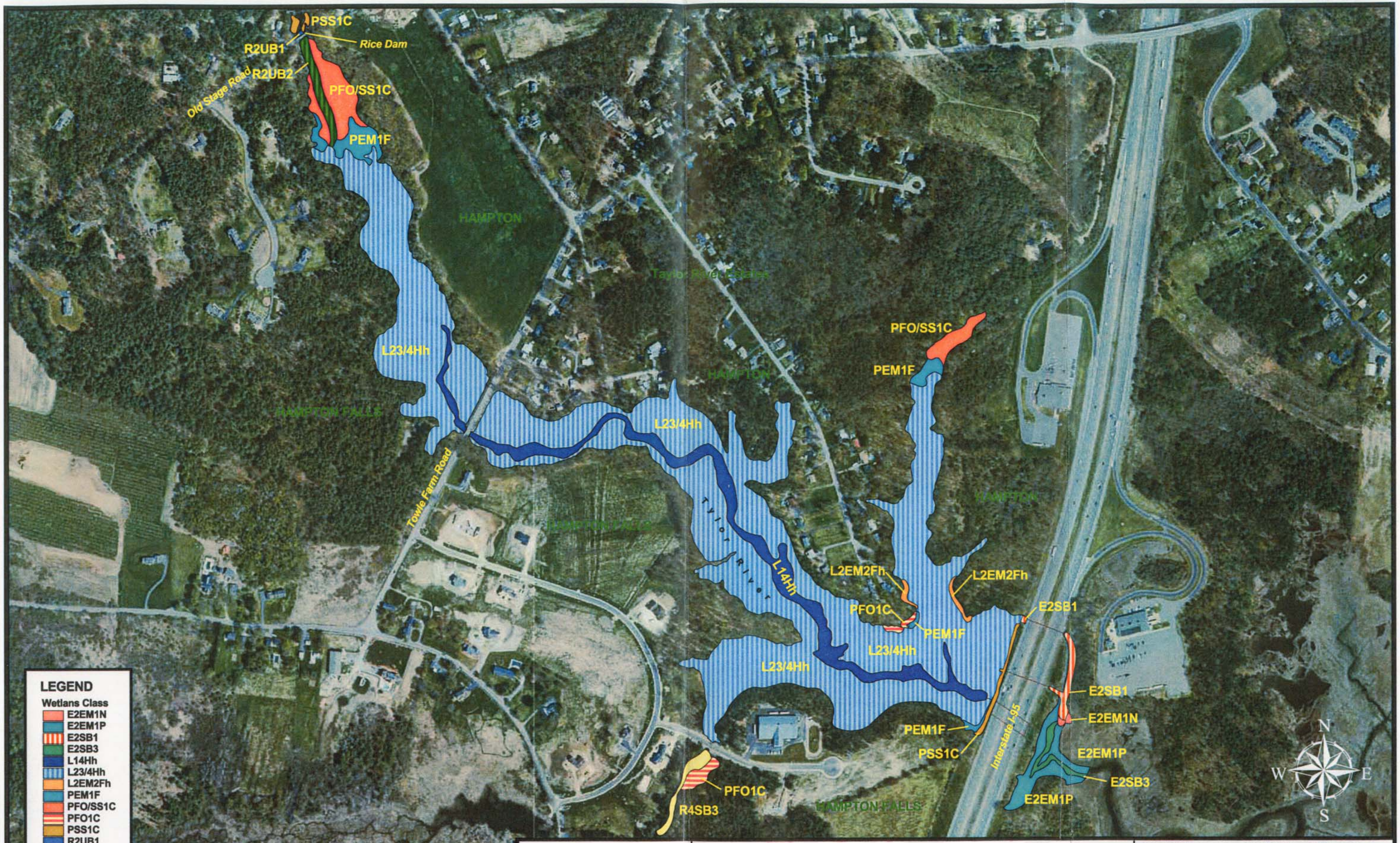


THE **Louis Berger Group,** INC.

Figure35_Water_EL.docx

Figure 36: Salinity downstream of Taylor River Dam.
The flow in Winnicut River identifies periods of rainfall; continuous flow data are not available for Taylor River.





June 2010

200 0 200 400 Feet

TAYLOR RIVER, HAMPTON FALLS, HAMPTON, NH

Fig. 37 WETLAND CLASSIFICATION MAP

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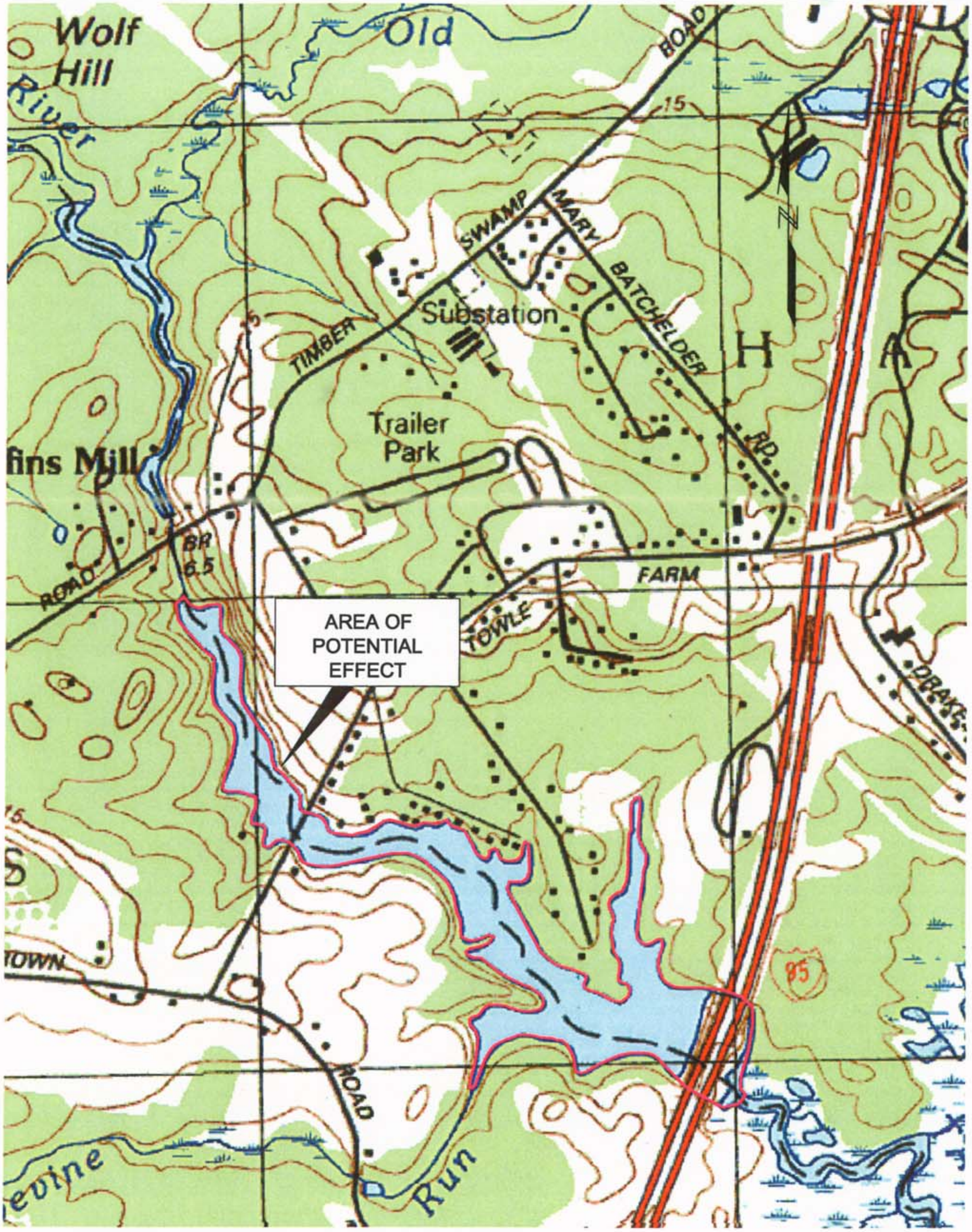

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LAST SAVED: 05/06/09 3:30PM BY:RTOBIN
DRAWING: C:\DOCUME~1\EDHIMA\LOCALS~1\TEMP\TEMPORARY DIRECTORY 1 FOR 064000-01 - STANDARD.ZIP\064000-01.DWG [FEASIBILITY STUDY]

REPLACEMENT OF 1-95 BRIDGE (NO.120/102) OVER TAYLOR RIVER HAMPTON AND HAMPTON FALLS, NEW HAMPSHIRE	Scale 1" ~ 1000'
THE Louis Berger Group INC. 1001 Elm Street., Suite 203 Manchester, NH 03101 — AREA OF POTENTIAL EFFECT FOR CULTURAL RESOURCES	June 2010 FIGURE 38

Appendix A

Bathymetric Survey Data ["Bathymetric Survey and Sediment Probing....", dated December 27, 2006, by HYDROTERRAEnvironmental Services, LLC.]

HYDROTERRA ENVIRONMENTAL SERVICES LLC
272 ½ Dover Point Road Dover, NH 03820
Phone (603) 743-5728 Fax (603) 742-3433
email - hydroterr @ aol.com

December 27, 2006

Mr. Rick Stewart, PE
The Louis Berger Group, Inc.
1001 Elm Street, Suite 300
Manchester, NH 03101

RE: Bathymetric Survey and Sediment Probing for the Taylor River Dam/Bridge Project - Hampton, NH (Job No. 899423-1)

Dear Mr. Stewart;

HYDROTERRA Environmental Services (HYDROTERRA) is pleased to provide you with this summary report for the Bathymetric Survey completed in the Taylor River, Hampton, New Hampshire to support engineering plans for the Taylor River Dam Project.

PROJECT UNDERSTANDING

The purpose of this hydrographic survey was to obtain river bottom elevation and physical characteristics of the Taylor River adjacent to Interstate 95 (I-95) and the Rice Dam sites. The approximate survey area location is shown on Figures 1 and 1A (the Study Areas).

HYDROTERRA conducted this river survey using a 10-foot survey boat equipped with a recording fathometer, hand sounding probes, a Differential Global Positioning System (DGPS), and an onboard computer hydrographic surveying system. The survey was conducted within Taylor River from approximately 400 feet downstream (west) of I-95 to the base of Rice Dam (approximately 6,500 feet) and approximately 1, 200 upstream east of I-95.

FIGURE 1 Study Area - Taylor River - West

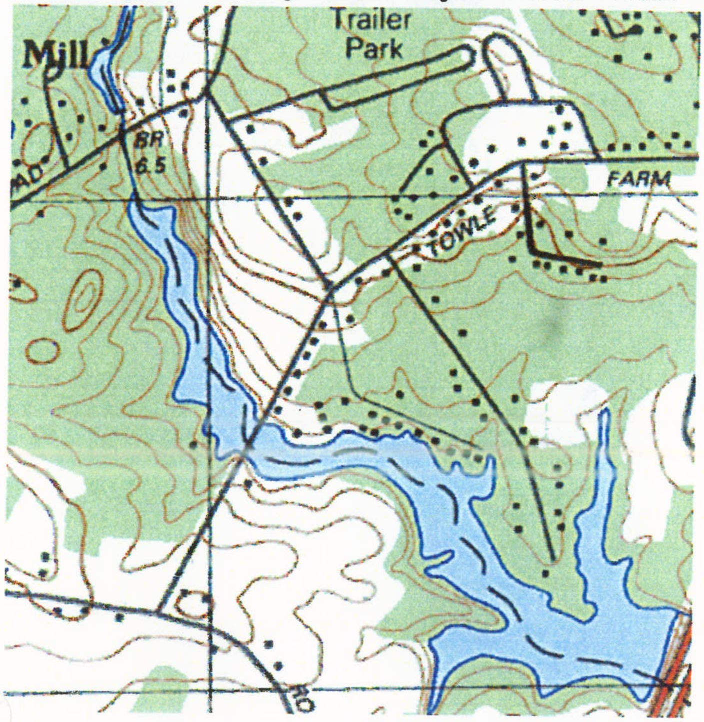
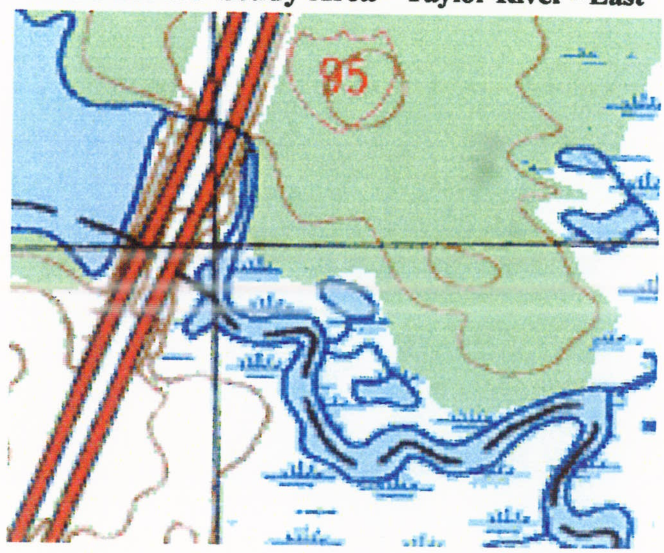


FIGURE 1A Study Area - Taylor River - East



WORK COMPLETED

River Bathymetric Survey

The bathymetric survey was completed using HYDROTERRA's survey boat equipped with recording fathometers, hand sounding probes, a Differential Global Positioning System (DGPS), an onboard computer and a hydrographic surveying software. The fathometers were calibrated using a metal striker plate and hand soundings. The onboard hydrographic surveying computer software collected and logged real time depth, water temperature, boat speed, bearing and positioning data on a 1 second interval. Field observations and operator notes, as well as hand sounding readings were also logged real time by the software.

Staff gages were installed to record surface water level changes during the survey. The location of these stations are shown on the bathymetric contour maps (see map folders - Attachment1). All sounding data was adjusted to the vertical elevation datum established by the New Hampshire Department of Transportation (NHDOT) (NGVD 29). Positioning data was reduced to New Hampshire State Plane System (ft) (1983) and Geodetic Latitudes and Longitudes (WGS 1984).

Data Presatation and Summary of Findings

HYDROTERRA reduced all sounding data and prepared hydrographic sounding contour maps for the Study Area. The Study Area was broken into two sub areas for presentation. The East Taylor River area was the survey area completed east of I-95, and theWest Taylor River area was the area west of I-95. The sounding contour maps are included in the map folders attached to the back of this letter report (Attachment 1). The West Taylor River area contour map was plotted at 1 inch equals 100 feet and was broken into three "D" size sheets. The East Taylor River area contour map was plotted at one inch equals 50 feet and includes only one "D"sheet. The Excel X,Y,Z sounding files for the survey are included on the CD (Attachment 2). Table 1 summarizes the electronic survey files included on the attached HYDROTERRA survey CD (Attachment 2).

TABLE 1	**Summary of Electronic Files**	
File Name	**File Type**	**File Content**
Taylor East	Excel (spreadsheet)	X,Y,Z Bottom Elev. file for Taylor River, east of I-95
Taylor West	.Excel (spreadsheet)	X,Y,Z Bottom Elev. file for Taylor River, west of I-95
Taylor-River-Probing	Excel (spreadsheet)	Bottom Probe Locations and Depths
Taylor-River-Bathy.dwg	DWG (AutoCad)	Bottom Elev. Contour Map for Taylor River, east of I-95 and Bottom Elev. Contour Map for Taylor River, west of I-95

Figures 2, 3, 4, and 5 presented 3D surface plots for the bathymetric river elevations for the east and west areas respectively. For the West Taylor River area, river bottom elevations were generally shallow with a confined river channel. Elevation ranges were between approximately 6 to 9 feet above sea level (ASL)(near shore) to 0 to -1 feet ASL (deepest channel locations). For the East Taylor River area, river bottom elevations were generally deeper with elevation ranges between approximately 0 to 2 feet ASL (near shore) to -6 to -7.5 feet ASL(deeper channel locations).

Please feel free to call me at (603) 743-5728 if you have any questions. HYDROTERRA appreciates this opportunity to provide you with these marine services.

Sincerely,

Jack M. McKenna, PG, PHG
Manager

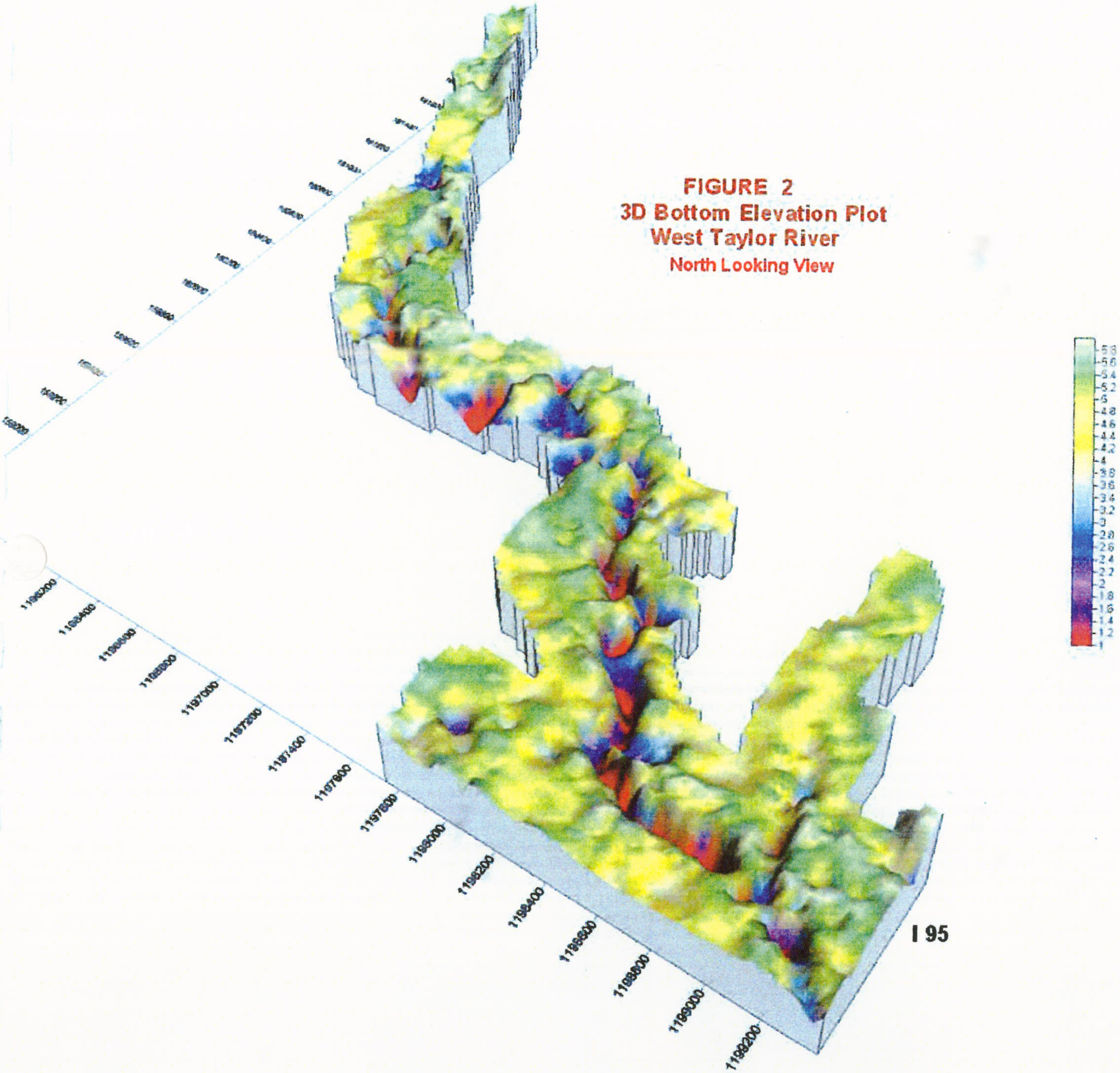


FIGURE 2
3D Bottom Elevation Plot
West Taylor River
North Looking View

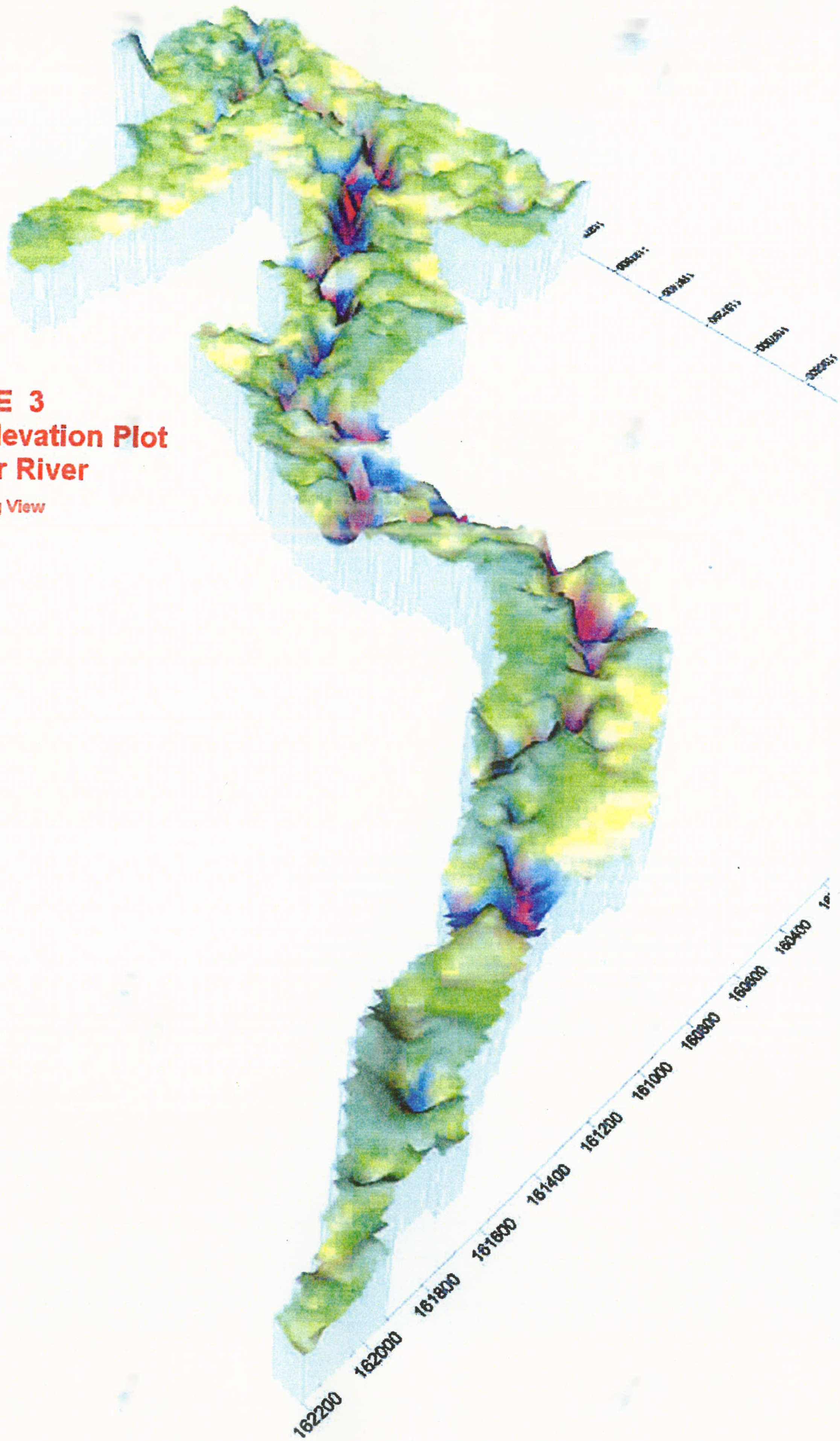
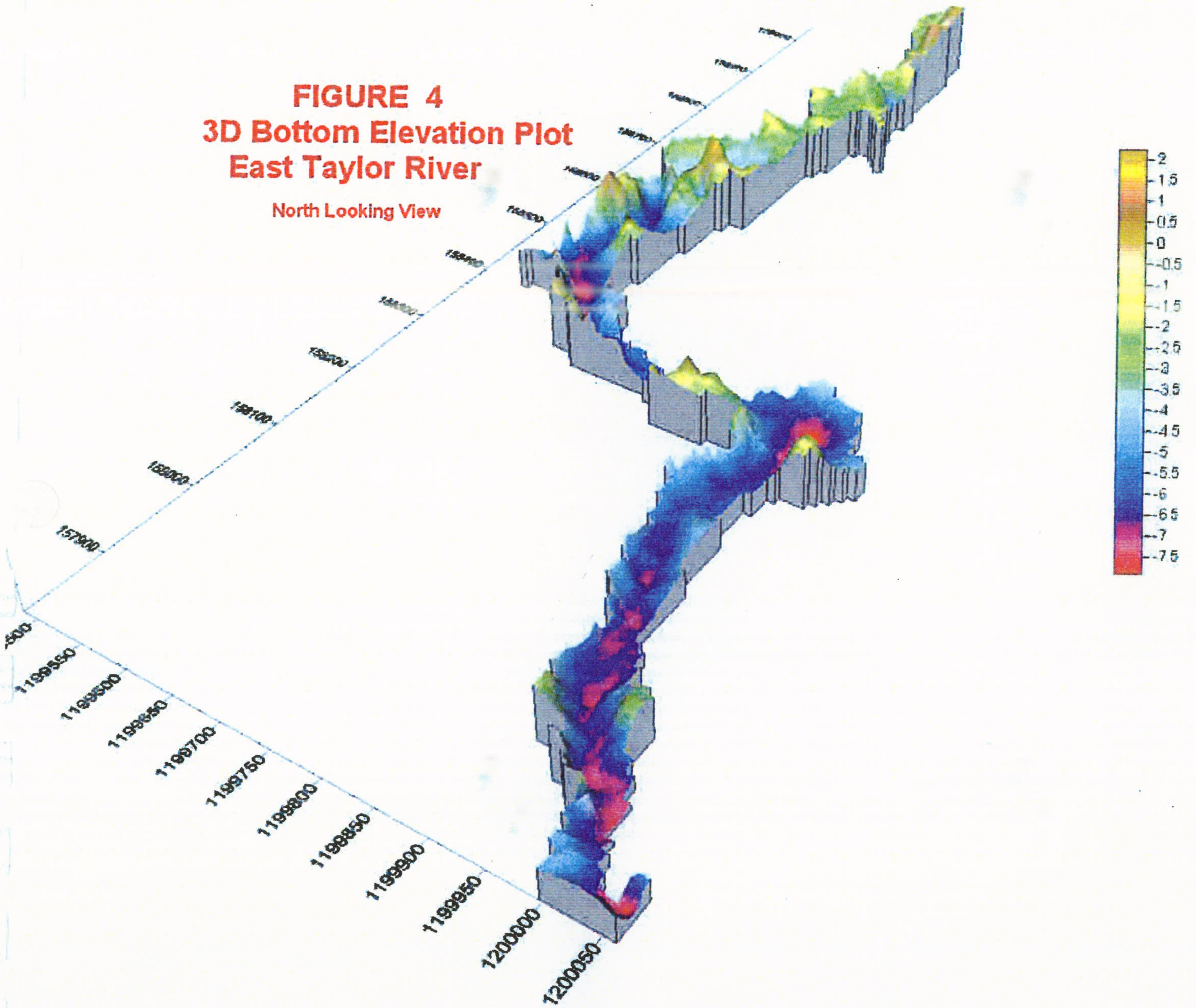


FIGURE 3
3D Bottom Elevation Plot
West Taylor River
South Looking View

FIGURE 4
3D Bottom Elevation Plot
East Taylor River

North Looking View



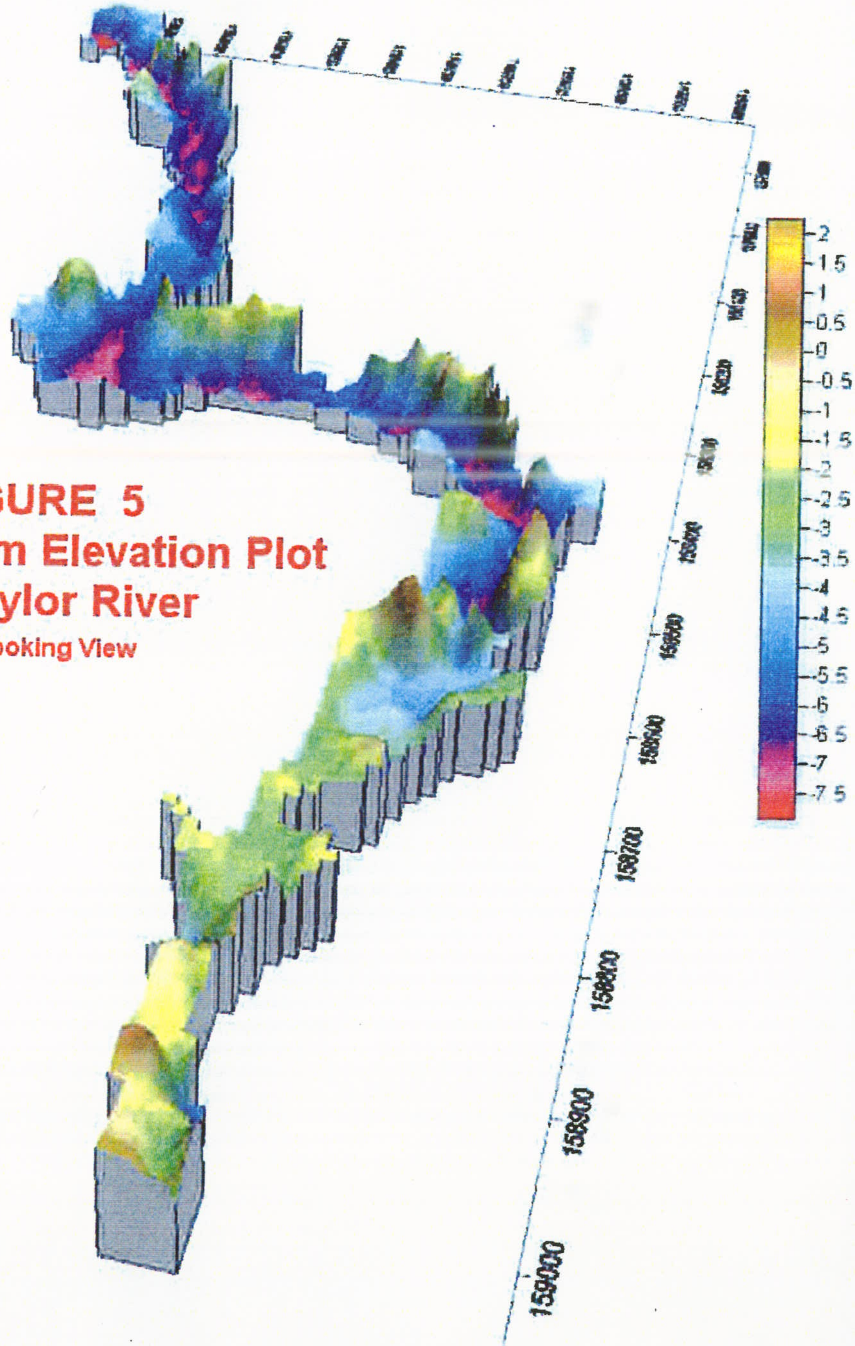


FIGURE 5
3D Bottom Elevation Plot
East Taylor River
South Looking View

ATTACHMENT 1
BATHYMETRIC CONTOUR
MAP FOLDERS

ATTACHMENT 2
BATHYMETRIC SURVEY
DATA CD

Keith
Craig
Wayne
WJB 2/1/05

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

New Hampshire Department of Environmental Services

DATE: January 25, 2005

FROM: Grace E. Levergood, P.E. **AT(OFFICE):** Water Division
Dam Safety Engineer gel Dam Bureau

SUBJECT: **Taylor River Pond Dam and Taylor River Pond Dike, Hampton Falls**
Dam #106.08 (Haz. Class A to B) and Dike #106.09 (Haz. Class AA)

Do they have authority to change dam class without public notice?

TO: Harvey Goodwin
NH Dept. of Transportation
Bureau of Turnpikes

On July 2, 2004, the State of New Hampshire Department of Environmental Services (DES) conducted a scheduled inspection of the aforementioned dam and dike. Under the provisions of RSA Chapter 482, Sections 8 through 15, DES is authorized to inspect all dams in the State, which by reason of their physical condition, height and location may be a menace to the public safety.

The following is the result of our file reviews and site inspection:

DAM #106.08:

1. The sheet pile spillway was badly deteriorated with a 12" diameter hole in the downstream face adjacent to the right abutment;
2. The downstream left concrete wall of the fishway that abuts the right spillway training wall was badly deteriorated with exposed rebar and leakage;
3. Cracking was evident along the left wall of the fishway;
4. The stoplog bay sill which forms the crest of the spillway was deteriorated;
5. There was settlement of the left abutment adjacent to the sheet pile training wall;
6. There is no operation and maintenance plan (O&M) on file with the DES; and
7. An Emergency Action Plan (EAP) is now required due to the reclassification of this structure.

RECEIVED
JAN 28 2005
BUREAU OF TURNPIKES

DES is recommending the following:

1. Make repairs to the steel sheet piling in the following locations:
   a. The spillway face
   b. The crest of the sheet pile spillway
   c. The left abutment wall which are badly deteriorated;
2. Make concrete repairs to the fishway in the following locations:
   a. The downstream left concrete wall of the fishway that abuts the right spillway training wall, is badly deteriorated with exposed rebar and leakage;
   b. The left wall of the fishway that is badly cracked;

WHY IS THERE SETTLEMENT?

3. Bring the left earthen embankment level with the left abutment wall where there is settlement;

4. Complete and submit to DES an O&M plan. Refer to the enclosed guidelines; and

5. Submit a draft EAP. Contact Ms. Bethann McCarthy for assistance with completing this document.

The dam was automatically classified as a low hazard, Class A dam due to its structural height being greater than 6 feet and the maximum storage behind the dam being greater than 50 acre-feet. However, upon examining the structure, the road embankment of Interstate 95 forms the dam. A failure of the primary spillway may cause minor damage to I-95. For this reason and according to Env-Wr 101.05 (d), the dam should be classified as a significant hazard, class B dam.

DES also recommends that Dam #106.09 be combined with #106.08 as one dam number due to the juxtaposition of the dams and our general policy to make immediately adjacent structures one.

culvert lining inbreast

Dike #106.09:

1. There was brush along the upstream face of the dam in the vicinity of the road culvert; and

2. There is no operation and maintenance plan (O&M) on file with the DES.

DES is recommending the following:

1. Remove the brush from the upstream face of the dam in the vicinity of the road culvert; and

2. Complete and submit to DES an O&M plan. Refer to the enclosed guidelines.

what does this involve?

In lieu of repairs to both the dam and dike, removal of the dam should be considered. A meeting was held on January 4, 2005 at NH Department of Transportation (DOT) in Concord to discuss proposed culvert replacement at the emergency spillway and fisheries issues. (See attached memo)

We strongly recommend that any dam repair activities, either to address the items noted above or otherwise, be coordinated with the Dam Safety Section of DES's Dam Bureau. Additionally, should any of these items result in a change in the structural configuration, height, length, or discharge capacity of the dam, a reconstruction permit will be required from the Dam Bureau. Likewise, should completion of any of these items fall under the jurisdiction of the Wetlands Bureau, an application to dredge or fill in the waters of the State may be necessary. If you have any questions relative to the aforementioned findings, please do not hesitate to inquire. Thank you.

Attachments: Sketch Illustrating Deficiencies, Guideline for an O&M plan, memo
cc: Mark Kirorac, NHF&G
Jim Gallagher, P.E., Chief Water Resources Engineer
Jimmy Leung, P.E., Maintenance Section
Bethann McCarthy, P.E., EAP Coordinator
John Nelson, Chief of Marine Fisheries, NHF&G
GEL/was/h:/safety/wendy/memo/10608&09mem2005.doc

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

FROM: Grace Levergood, P.E. gel
Dam Safety Engineer
Dam Bureau

DATE: January 12, 2005
AT: Environmental Services
Water Division

SUBJECT: Taylor River Pond Dam, Hampton Falls, NH
Dam #106.08

ATTENDEES: Kevin Nylan, Wayne Brooks, Bill Hauser – DOT
Cheri Patterson, NHFG
Grace Levergood, Ted Diers, Jen Droziak - DES

A meeting was held on January 4, 2005 at NH Department of Transportation (DOT) in Concord to discuss proposed culvert replacement at the Taylor River Pond Dam emergency spillway and fisheries issues. Plans are underway at DOT to line the badly corroded CMP pipe arch culvert that goes under I-95 from the emergency spillway by September 2005. The culvert was inspected by a DOT consultant and found to be in very poor shape. Although not inspected at the same time, the bridge under I-95 at the main spillway is also suspected to be in need of repairs due to its sheet pile make-up. Suggestions were made to forego the repair work on the CMP pipe arch culvert and use the money towards another project. A proposed feasibility study would look at the option of replacing the main spillway with a natural fishway and possibly eliminating the need for the emergency spillway and pipe arch culvert.

NHFG commented that the fish ladder does not function as intended. Also fish are trying to move up the pipe arch culvert with ends at the emergency spillway and has no fish passage instead of moving further upstream to the fish ladder at the main spillway. See the attached NHFG report that discusses the drastic decline in fish passed by the ladder as well as the degraded water quality in the pond upstream of the dam.

Next steps will include:

- Ted Diers of the DES Coastal Program will have Milone & MacBroom and Dick Quinn of USFWS will examine the site and give their expert advice on fish passage.
- DES Dam Bureau will issue their dam safety inspection report to DOT.
- DES and NHFG will develop a dam removal/fish passage concept to DOT.

H:\safety\dams\memo\10608gelmem.doc

Taylor River Dam and Fish Ladder

Diadromous fish were denied access to freshwater portions of New Hampshire's coastal rivers to complete their life cycle with the construction of dams in the nineteenth century. The construction of six fishways on five coastal rivers in the late 1960's and early 1970's (Exeter, Lamprey, Oyster, Cocheco and Taylor Rivers) provided anadromous fish access to many acres of freshwater spawning and nursery habitat. Deterioration of these structures due to normal aging make it necessary to assess their effectiveness in passing fish and the reason for impounding water.

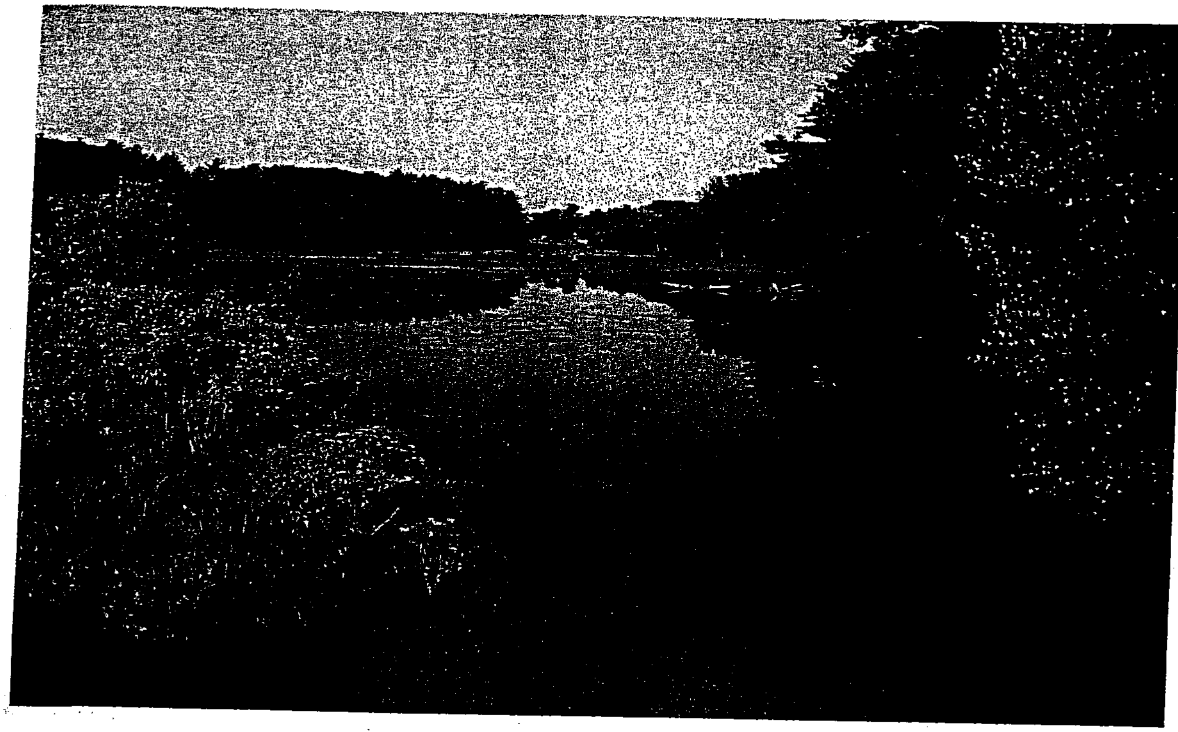
The majority of anadromous fish using the fishways in the spring are alewife and blueback herring (river herring). Adult and juvenile river herring are a very important forage fish for inland, estuarine, and coastal species. For example, juvenile river herring provide a forage base within inland rivers and lakes for such freshwater species as bass and pickerel. In addition, juveniles and adults migrating between the ocean and natal rivers are preyed upon by many sportfish (striped bass, bluefish, etc.) within the Great Bay and Hampton/Seabrook Estuaries. Also, fishermen net adult river herring during the spring spawning run to be used as bait for sport fishing or lobster.

The Taylor River in Hampton/Hampton Falls, New Hampshire has 45 acres of available spawning and nursery habitat between the head of tide dam and next upstream dam. This river system has experienced the most dramatic decline in river herring spawning runs than any other coastal river. The Taylor River had the highest recorded river herring runs (1976 passed 450,000 river herring) in coastal New Hampshire rivers but now is one of the lowest runs (2003 passed 1,300 river herring). This impoundment also has indications of potential water quality concerns as noted in the following pictures with the large growth of algae and weeds during the summer months.

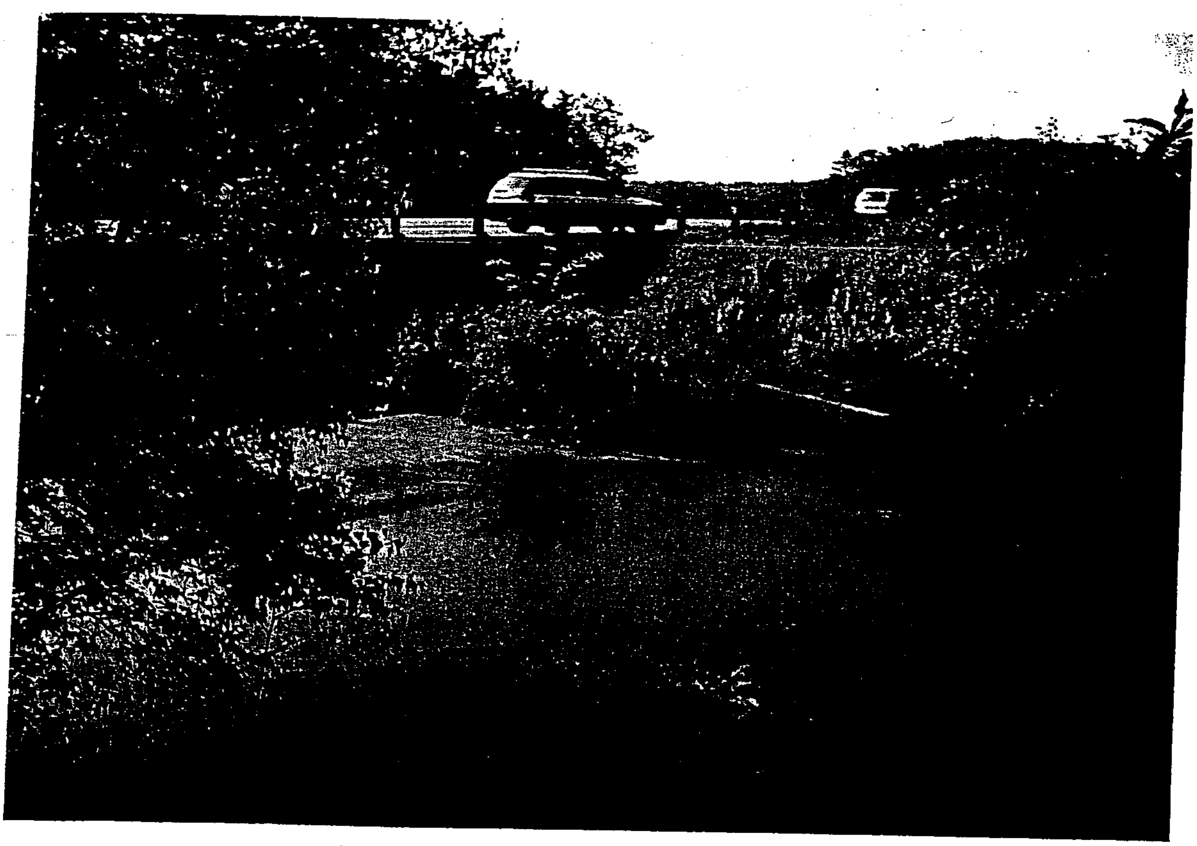
Currently, portions of the cement walls in the Taylor River fish ladder contain substantial holes that allow water to escape thereby reducing its efficiency in attracting and passing a variety of diadromous fish. The Department of Transportation (DOT) owned concrete and steel dam adjacent to I95 also is in severe disrepair that is affecting the integrity of this class A dam. A Department of Environmental Services (DES) dam inspection has been initiated and the final report will be given to DOT in late 2004. At this point New Hampshire Fish and Game, DES and DOT hope to confer on the next logical steps to be taken to remedy this situation of deteriorated structures, water quality and viable habitat for diadromous species utilizing this river system. This may be in the form of repairing the structures or dam removal.

Since the remedial process is still in the early stages between all agencies involved there is no definitive agreement on how to proceed with a grant award towards this project. This should be better defined by spring of 2005.

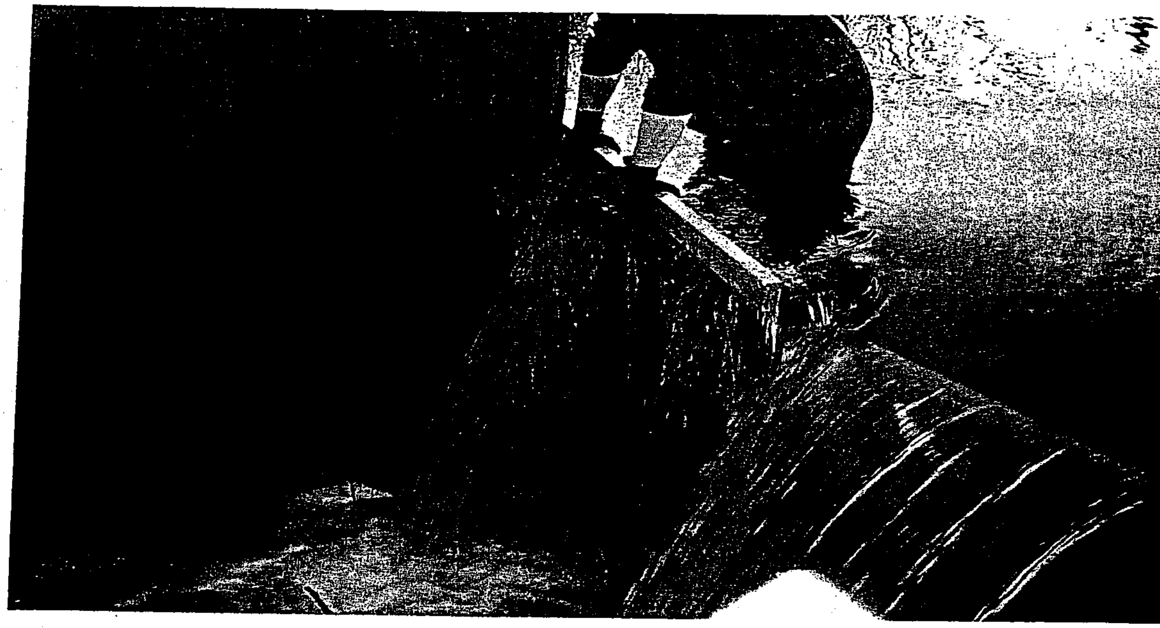
Picture 1. Taylor River impoundment – upstream of dam (west side of I95) – August 2004



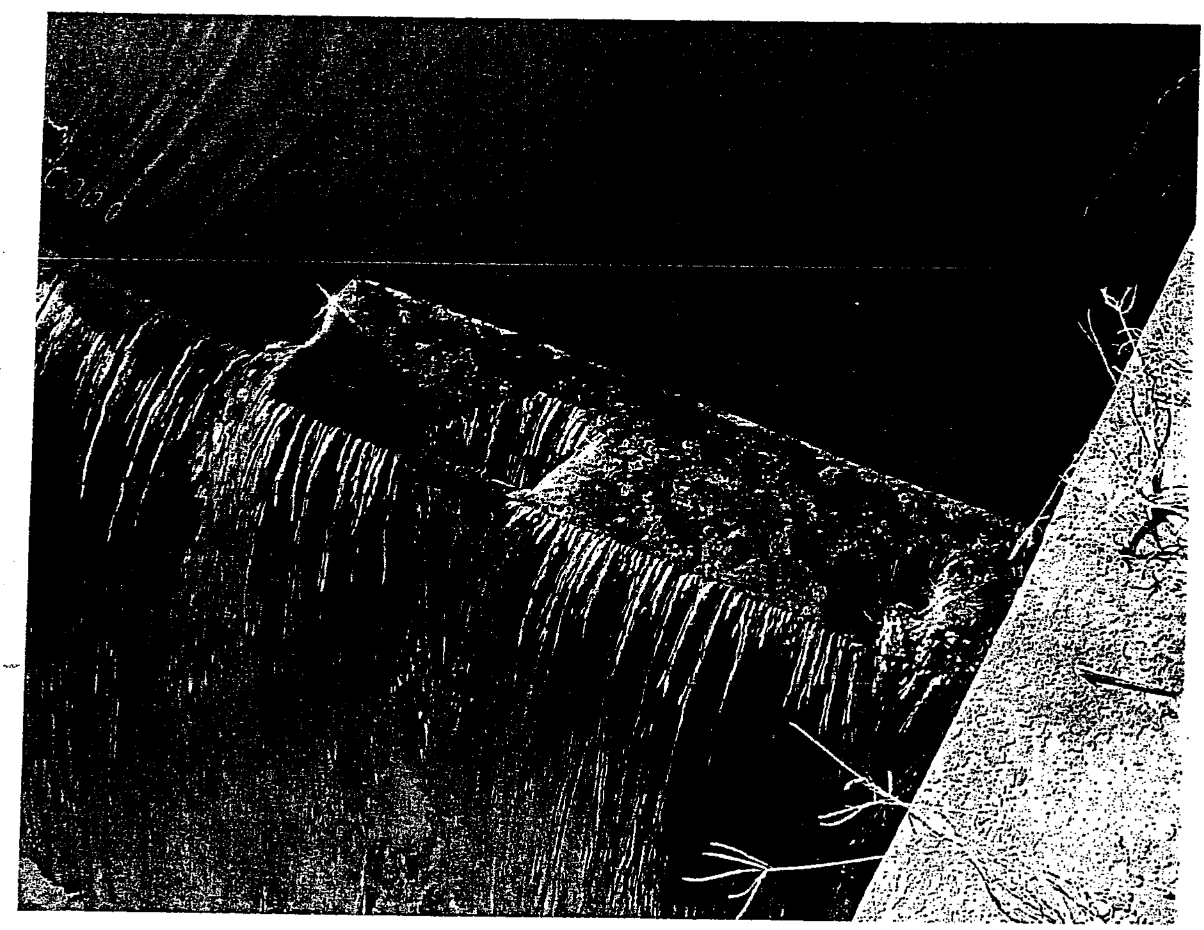
Picture 2. Taylor River fish ladder exit – West side of I95 – August 2004



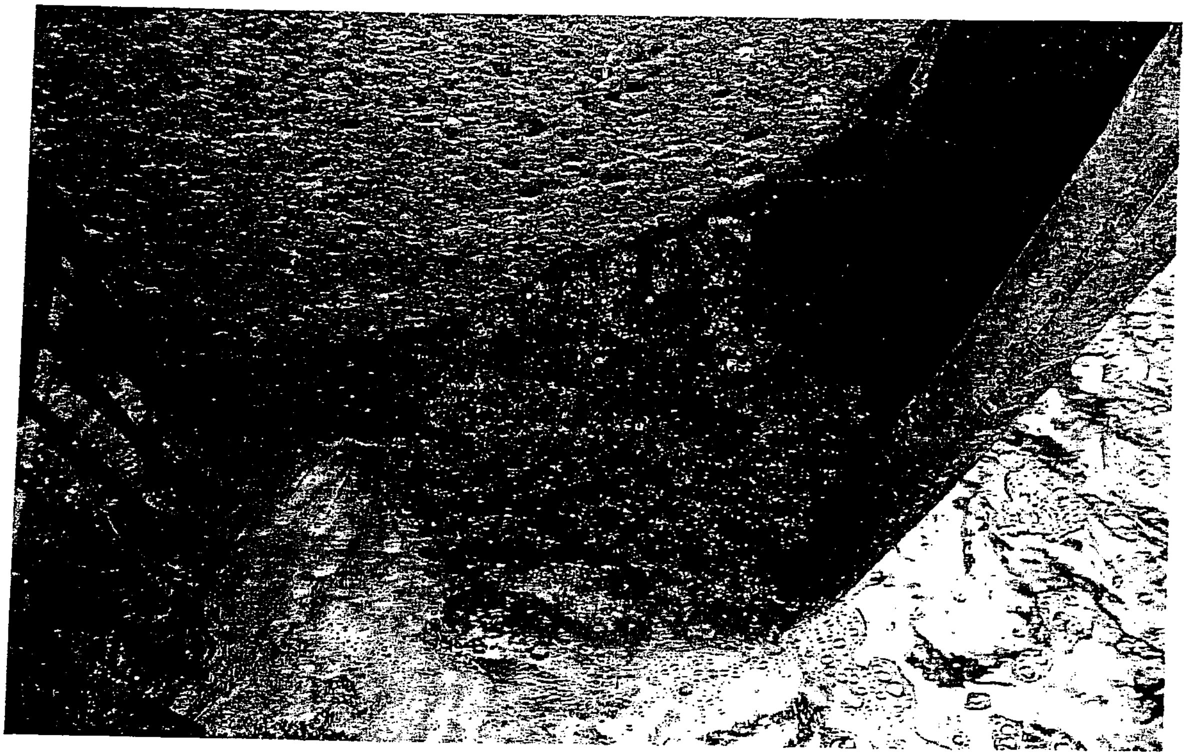
Picture 3. Taylor River dam – water flowing through hole in dam alongside fish ladder entrance – November 2004.



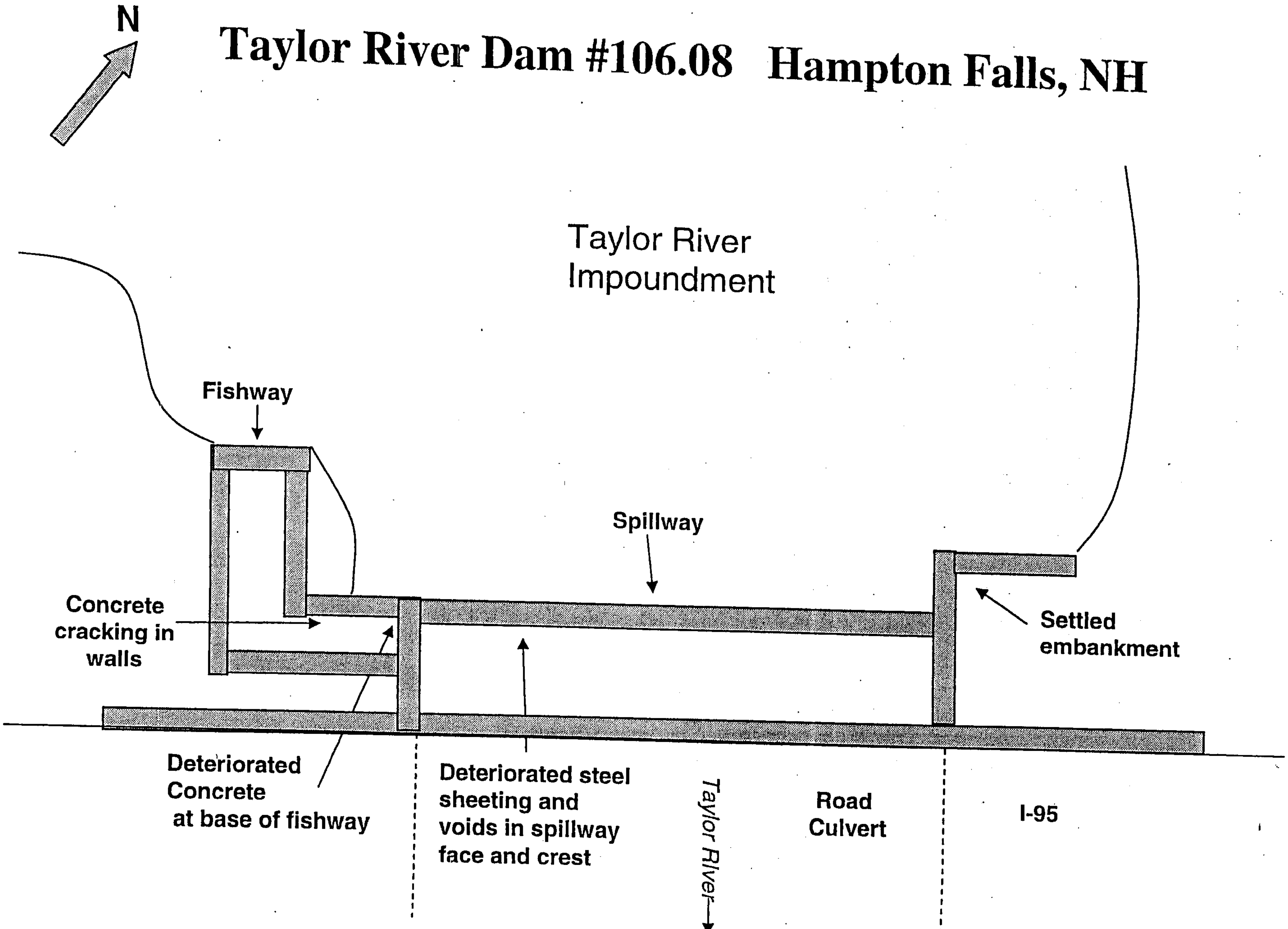
Picture 4. Taylor River dam – two holes on top lip of dam on opposite side of fish ladder entrance – November 2004.



Picture 5. Taylor River fish ladder – deterioration at entrance of fish ladder – August 2004.



Taylor River Dam #106.08 Hampton Falls, NH



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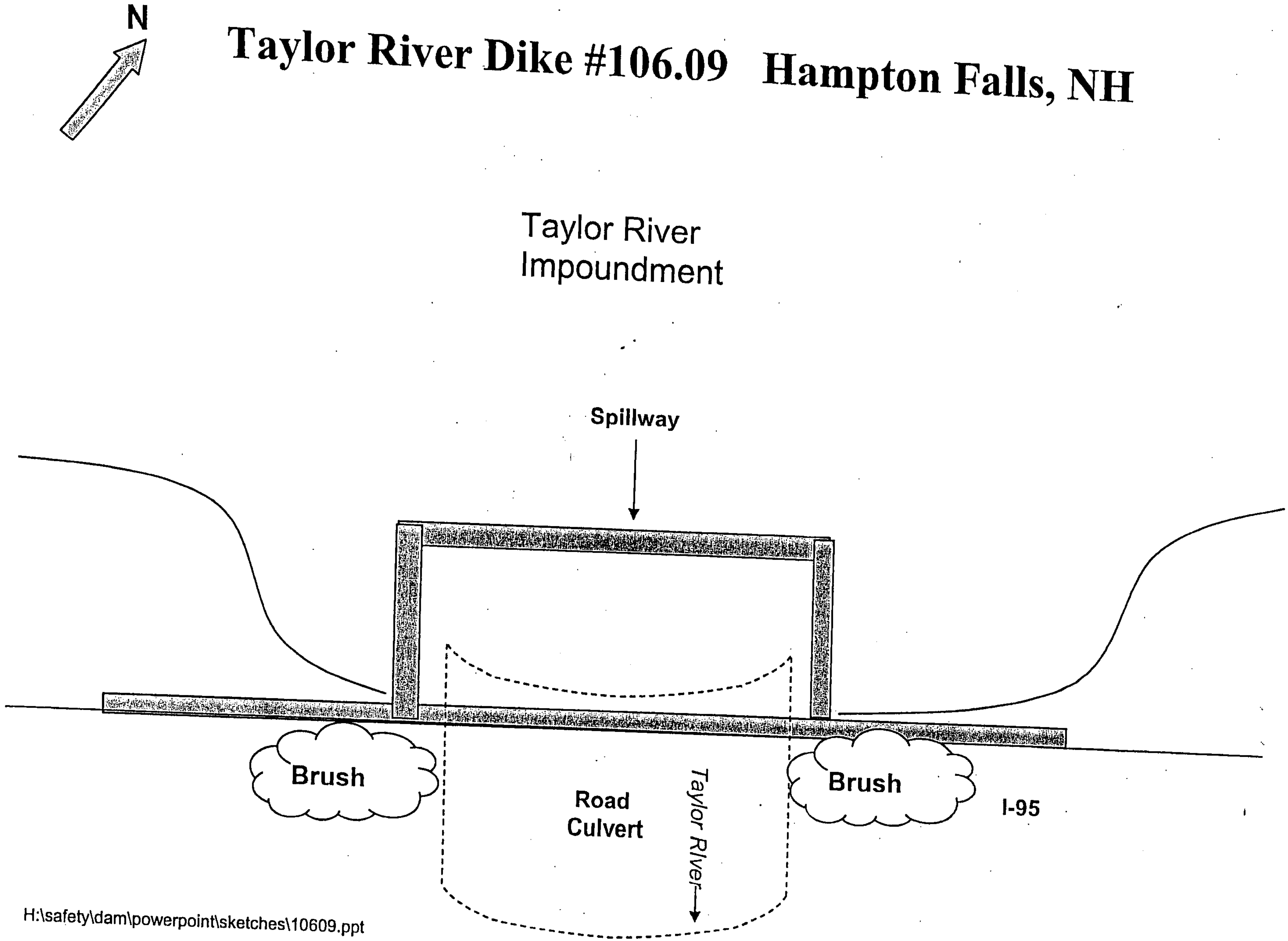
Taylor River Dike #106.09 Hampton Falls, NH



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MOUNTAIN POND DAM O&M
Conway, NH
Dam# 052.38

Seasonal Operation

During the summer season the pond level is maintained at the top of the concrete spillway with no specific operations made. After Columbus Day three (3) stoplogs are removed and the pond is lowered approximately two (2) feet to provide for spring runoff flows.

Emergency Operation

When an excessive rain or spring thaw event is ongoing the pond level and dam are checked every six (6) hours or so. If the pond level shows a steady rise the stoplogs are removed and the gate is opened appropriately to try to match the inflow to the pond.

Maintenance Program

Weekly

- The dam is checked to ensure that no floating debris is restricting outflow.
- An abbreviated walk-through inspection is made of the entire dam with special attention to the cracking in the pier between the spillway and the stoplog bay and to the wet areas along the downstream toe of the dam. Observations are noted in logbook.

Semi-annually

- The embankment vegetation is inspected and any trees or brush that have taken root are removed.
- Any bare or eroded areas of the embankment and abutments are repaired and seeded.

Annually

- The gate mechanism is inspected, repaired and lubricated as necessary.
- The gate is opened to verify that it is operable.
- The integrity of the wooden stoplogs is assessed and are replaced as necessary
- After Columbus dam, with the water level lower, a detailed inspection of the embankment, abutments and concrete surfaces is made and any deficiencies, which are noted, are repaired. The results of the annual inspection are documented in the logbook for future reference and are routinely compared with the previous years inspections.
- The Emergency Action Plan (EAP) is tested.

Emergency Contact Person

Mr. Robert Jones – Dam Owner
Home Tel#: 603-555-1234
Work Tel#: 603-555-6789

It has been determined that a failure of this dam would endanger two (2) town road crossing, Smith road – 0.50 miles downstream and Jones road – 1.00 miles downstream. During extreme high water events, or if a serious problem exists with the dam, the Town of Conway is notified so that if resources exist they may monitor the roads.

(SKETCH OF DAM)

Craig,
I printed out
the Env-Wr. authority
in memo.
Keith

Department of Environmental Services
Water Division
64 No. Main Street
Concord, New Hampshire 03301
Tel. No. (603) 271-3406

CHAPTER Env-Wr 100 ORGANIZATIONAL RULES

PART Env-Wr 101 DEFINITIONS

Env-Wr 101.01 "Acre-foot" means the volume of water that would cover one acre to a depth of one foot.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.02 "Breached dam" means a dam which no longer impounds water during the design storm event as specified in Env-Wr 504.10.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.03 "Class AA structure" means a dam the failure of which would not threaten life or property and meets the following criteria:

(a) Is not greater than 6 feet in height with a storage capacity greater than 50 acre-feet.

(b) Is not greater than 25 feet in height with a storage capacity greater than 15 acre-feet.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.04 "Class A structure" means a dam with a low hazard potential, the failure of which

would result in any of the following:

(a) No possible loss of life as defined in Env-Wr 101.29;

(b) Minimal economic loss;

(c) Major damage to town and city roads; or

(d) Minor damage to Class I and II state highways; or

(e) The release of liquid industrial, agricultural, or commercial wastes or municipal sewage if the storage capacity is less than 2 acre-feet and is located more than 300 feet from a waterbody or water course.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84; rpld by #4491, eff 9-20-88

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.05 "Class B structure" means a dam with a significant hazard potential, the failure of which would result in any of the following:

(a) Possible loss of life;

(b) Significant economic loss;

(c) Major damage to Class I and Class II state highways;

(d) Minor damage to interstate highways;

(e) Loss of a municipal water supply reservoir which constitutes more than 50% of a community's source or whose loss could endanger public health; or

(f) The release of liquid industrial, agricultural, or commercial wastes or municipal sewage from dams which do not meet the criteria in Env-Wr 101.04(e).

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84; ss by #4491, eff 9-20-88; ss by #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.06 "Class C Structure" means a dam with a high hazard potential the failure of which would result in any of the following:

(a) Probable loss of life; or

(b) Major damage to interstate highways.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.07 "Consumptive use" means all uses which are not nonconsumptive as defined by Env-Wr 101.25.

Source. #1716, eff 2-20-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.08 "Dam" means "dam" as defined by RSA 482:2,II, namely "any artificial barrier, including appurtenant works, which impounds or diverts water, and which has a height of 4 feet or more, or a storage capacity of 2 acre-feet or more, or is located at the outlet of a great pond. A roadway culvert shall not be considered a dam if its invert is at the natural bed of the water course, it has adequate discharge capacity, and it does not impound water under normal circumstances. Artificial barriers which create surface impoundments for industrial, or commercial wastes or municipal sewage, regardless of height or storage capacity, shall be considered dams".

Source. #1702, eff 1-1-81; ss by #2207, eff 12-13-82; ss by #2900, eff 11-7-84, EXPIRED 11-7-90

New. #5080, eff 2-22-91; ss by #6462-A, eff 2-21-97

Env-Wr 101.09 "Dam in disrepair" means "dam in disrepair" as defined by RSA 482:2,V, namely "a dam which is a menace to public safety, or incapable of safely impounding the full waters to its crest, or incapable of maintaining a reasonably constant level of waters impounded, or one which does not contain adequate gates and sluiceways to provide for the holding or controlled discharge of waters impounded."

January 5, 2005

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DESIGN

CONFERENCE REPORT

PROJECT: Statewide Culvert Repairs
IM-X-000S(397)
13408
(Various locations throughout the state on Interstate and Turnpike systems)

DATE OF CONFERENCE: January 4, 2005

LOCATION OF CONFERENCE: Aeronautics Conference Room

ATTENDED BY:

NHDOT	NHDES	NH Fish and Game
K. Nyhan	Ted Diers, NH Coastal Program	Cheri Patterson, Marine Fisheries
W. Brooks	Jen Drociak, NH Coastal Program	
W. Hauser	Grace Levergood, Dam Bureau	

SUBJECT: Hampton over-flow structure at the Taylor River outlet

NOTES ON CONFERENCE:

Mr. Brooks provided some background information on the project highlighting the statewide culvert inspection that was done under an earlier contract with Louis Berger Group. He noted that the current contract was intended to address the culverts that were in the worst condition and in need of immediate repair. He noted that the scope of work for this project was to slip-line the existing 6'-1" high x 8'-10" wide steel plate pipe-arch culvert with a smooth interior plastic pipe at a cost of about $200,000. Mr. Brooks noted that the Department has considered the culvert structure to be a separate structure apart from the Bridge and dam 300' north of the culvert. It was noted that NHDES considers the Taylor River outlet to consist of two structures, the dam and the overflow structure, each having an identifying number.

Mr. Brooks noted that Turnpikes has reviewed the structures and recognizes their current poor condition. The existing bridge consists of driven steel sheet piling 15' wide, 10' high with a concrete deck. The dam is immediately upstream of the bridge, also being constructed of driven sheet piling, and is integrated with the bridge structure. There is also a fish ladder that is part of the dam structure, allowing for migration of fish from the salt water to fresh water river networks. Turnpikes has noted that the dam has undergone repairs in the past, correcting corrosion problems.

Ms. Patterson noted that the dam connected to the bridge structure is in very poor condition having many leaks and holes. She stated that the leakage of the dam has undermined the fish ladder, causing concrete spawling. Ms. Levergood stated that the recent inspection report has not been sent to Turnpikes yet, but will indicate the dam to be in very poor condition and in need of major repairs in the near future. Mr. Diers indicated that NHDES has some money and is seeking additional funding for a comprehensive study of the Taylor River watershed and would like to address the dam and fish ladder to improve fish passage through the structure(s). It was noted that NH F&G and DES are planning on bringing experts in fish passage to conduct a preliminary study over the next couple months, a study which will help to identify the potential alternatives to look at in a more comprehensive analysis." Ms. Levergood noted that the

hydrologic model indicated that the secondary pipe-arch may not be necessary with a redesign of the dam structure. It was requested that the Department consider delaying performing work on this culvert until a design for the new dam structure is known and possibly divert the current project funds to this end. Mr. Brooks noted that addressing the dam would likely require also addressing the bridge structure, which would require much more work and funding than is currently available. Mr. Hauser noted that the Ten Year Plan did not currently have a project dedicated to replacing the bridge. He also noted that a considerable amount of the cost would be for traffic control. Mr. Brooks agreed to review the possibility of an interim treatment to the culvert, lasting up to five years to allow for completion of the study. This may save much of the original project cost. Mr. Brooks will discuss this again with Turnpikes and Project Development once the dam inspection report is available. Mr. Brooks noted that if the study revealed a larger project, including complete bridge replacement then replacing the culvert may be necessary. It was agreed that it would be desirable to save the cost of the culvert repair if replacing the other structures is imminent.

Submitted by:

Wayne Brooks

Wayne Brooks
Consultant Supervisor

WPB/wpb/

Noted by: W. Hauser _WH___, K. Nyhan__KN____, T. Diers___TD__
cc: K. Cota, J. Moore, M. Pillsbury, H. Goodwin
S:\STATEWID\13408\CONFRPTS\102004.DOC

RECEIVED
OCT 12 2006
GEI CONSULTANTS, INC.

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

FAX TRANSMISSION
Water Division – Dam Safety
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095
Phone: (603) 271-3406
Fax: (603) 271-7894

Rice Dam

Date: Oct 12, 2006

To: Rich Tobin

Company: GEI

Fax #: 781-721-4073

From: Grace Levergood

Phone #: 603-271-1971

Comments:
Attached is the lastest trip report to the dam. Also have included the hydrology and hydraulics for the dam.

Number of pages: 7 (Including cover letter)

Type of Action
✓ Regular Inspection
___ Follow-up Inspection
___ Post-const. Inspection
Other___________

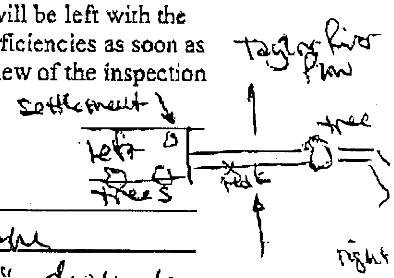
NH Department of Environmental Services
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095
(603) 271-3406
web site: www.des.state.nh.us

New Hampshire Department of Environmental Services

SITE INSPECTION FORM

Dam Name: Taylor River Pond Dam #: 106.06 Town: Hampton Falls
Date: 7/2/04 Owner: Fran Rice

The following is a listing of findings and, if appropriate, recommendations based upon the evaluation associated with the above referenced dam. The owner or his/her representative should implement the recommendations listed on this form, which are aimed at improving the safety of the dam. This form, a copy of which will be left with the owner or owner's representative, is intended to make dam owners aware of easily correctible deficiencies as soon as an inspection is carried out. More formal compliance notices may be issued after a detailed review of the inspection notes and photographs has been made.



Inspection Findings & Recommendations:

Remove trees and brush
① Brush and trees on left abutment of dam
2 trees measured greater than 12" diameter
Tree along downstream face of dam to the left of low level gate

② Leakage noted in several locations along upstream spillslab - water migrating beneath concrete slab through stonework - unable to maintain normal pool level in pond.

③ Left abutment and earth interface has settled and cracked.

④ Concrete cap on spillway is cracked and deteriorated

⑤ Please complete an operation and maintenance plan and submit to DES - refer to guidelines.

⑥ Exercise low level gate (in fall)
⑦ Sediment buildup in impoundment

⑧ In place of repair consider dam removal - Contact Stephanie Lindloff at #271-3406 funding may be available.

Owner/Owner Representative:__________ Form left w/Owner/Rep?: yes no

DES Inspector: Grace Levergood Please contact Inspector with any questions.

Distribution: WHITE – File YELLOW – Owner/Rep. PINK - Inspector

Idylw River Pond Dam 11106.06 — 11-24-04 OZC

	FILE	REVIEW
DA =	9.75 mi²	8.47 mi²
HT =	14 ft	
LENGTH =	125 ft	
SA =	6.3 AC	6.3 AC

Wastel10.apr

AO issued - 10/28/92

COD issued 6/3/98

Q50 = 903 cfs
432 cfs → Potters

HydroCAD ver6.0
492 cfs in
463 cfs out
pk elev = 18.17'

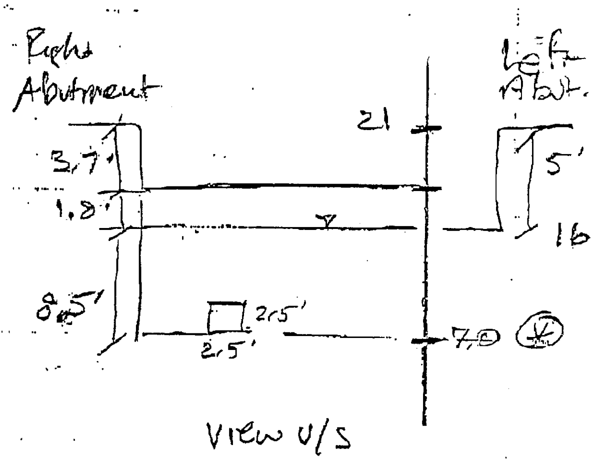
Qdwh = 2165 cfs

OUTLETS

1 - 52' w. x 5' h spillway

1 - 10' w x 3.7' h spillway

1 - 2.5' x 2.5' low level gate

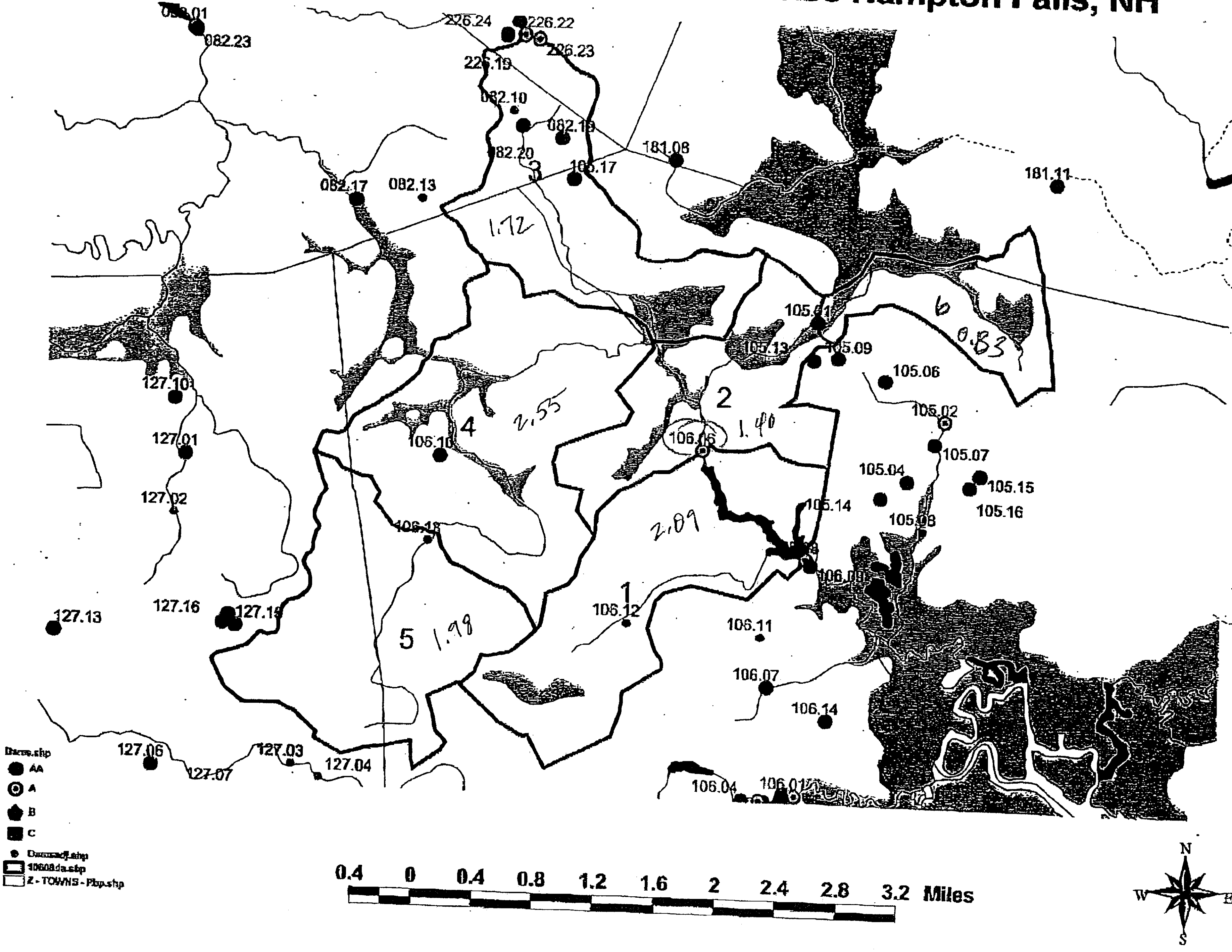


STORAGE	ELEV	SA	AC-FT	FILE
MAX	21	10	10(5) + 18.7 = 68.7	68.8
PERM	16	6.3	0.33(9) 6.3 = 18.7	20.8
BOT	7	0		

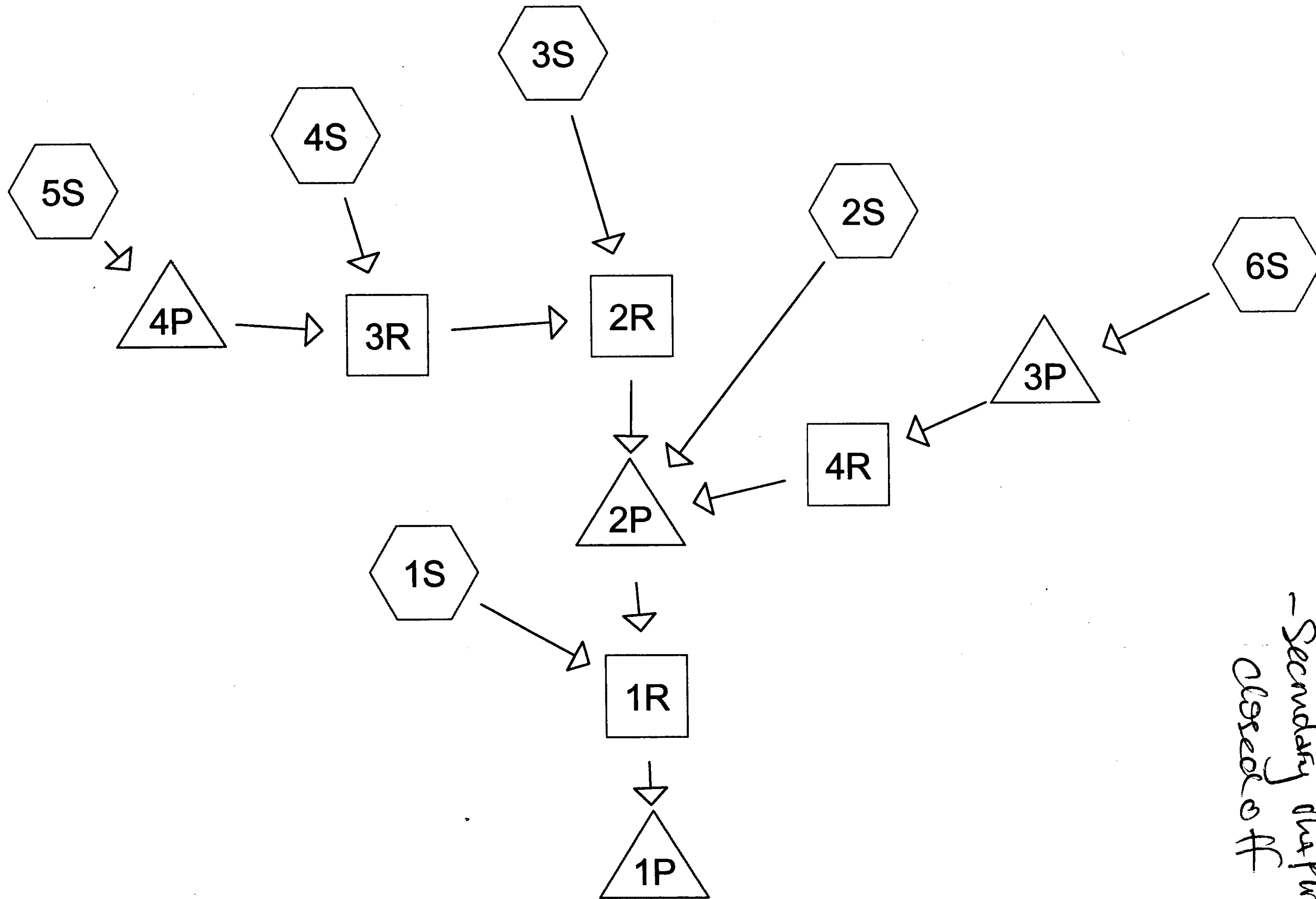
Brown Rd
D/S Bridge 250' d/s 2 - 12' w x 12.5' h openings
INV = 14'

(*) BA = 6.5 m USGS NAD = 21.3'

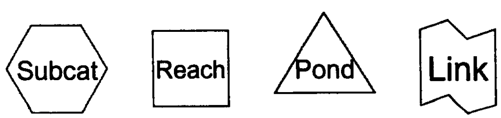
Drainage Area for Taylor Pond Dam #106.~~08~~06 Hampton Falls, NH



10/17/2006 09:59 WATERSHED MANAGEMENT BUREAU → 917817214073 NO.984 D04



- Q100
- Secondary outflow closed off



Drainage Diagram for 10608taylor
Prepared by {enter your company name here} 5/24/2005
HydroCAD® 6.00 s/n 001850 © 1986-2001 Applied Microcomputer Systems

Taylor River Pond Dam #106.08 11-19-04 GEL

	FILE	ARCHIVE
HT =	21 ft	18.5
LENGTH =	50 ft	
DA =	12.5 mi²	10.57 mi²
SA =	45 Ac	37 Ac

Coastal 10. apr

106.06 HIH 5/98 dme

185 186 quads

HydroCAD ver 6.0

Q_{50} inflow = 626 cfs pk elev = 11.27'
outflow = 418 cfs

Qdischarge = 2038 cfs 1700 cfs w/' frbrd

Also Dam #106.09

OUTLETS

100 yr 6.5" Rainfall

1 - 15½' wide x 3h stoplog bay with d/s fish passage chute

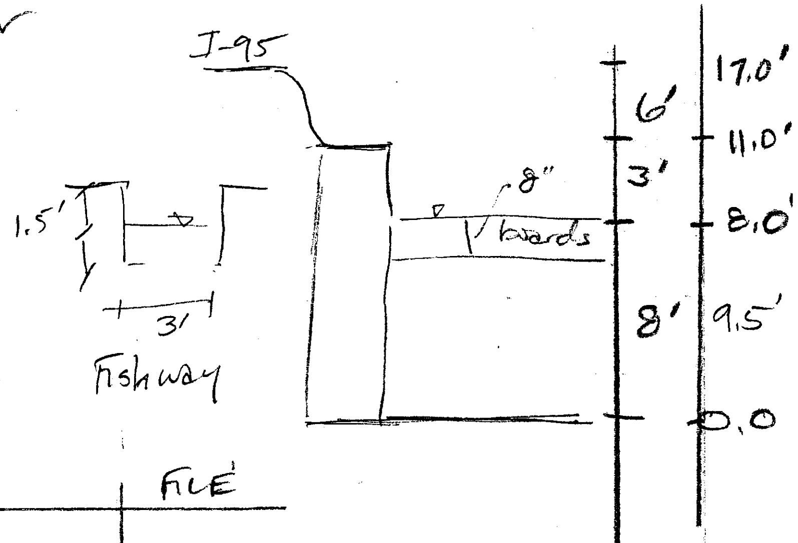
1 - 3' wide fish ladder

Dam #106.09 Em. Spwy

secondary

1 - 35.5' long x 1.5' wide overflow weir

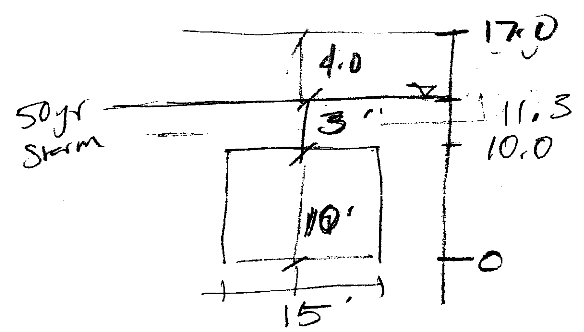
Qdischarge = 506 cfs



STORAGE	ELEV	SA	AC-FT	FILE
MAX	17.0	45	9(45) + 98 = 503	
PERM	8.0	37	0.33(8) 37 = 98	
BOT	0.0	0	0	

D/S Road Culvert I-95

Qdischarge = 1658 cfs



Dams in Watershed

#106.09 2nd outlet for Taylor Pond
#106.06 A Taylor River Pond (51AC) Rice Dam

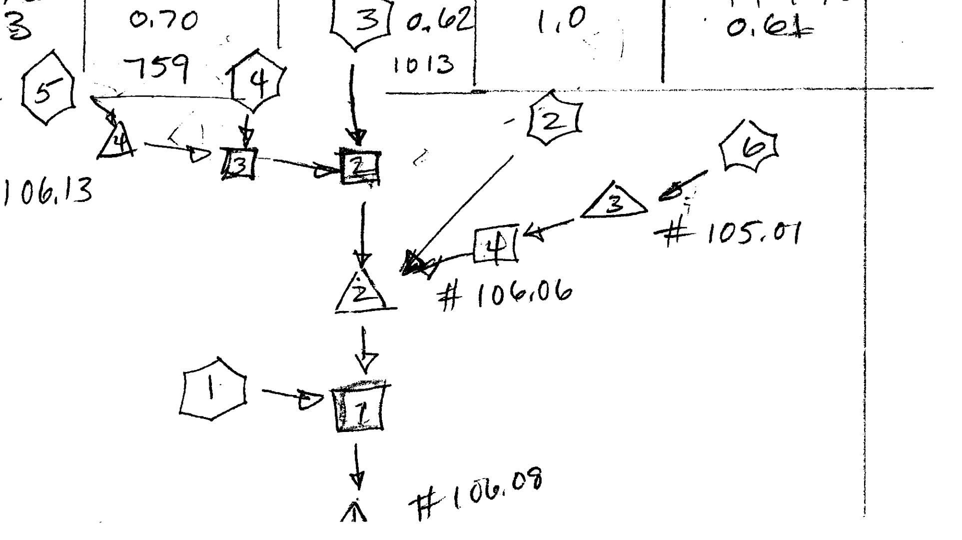
#105.01 AA Car Barn Pond

#106.13 — Taylor River Dam never built 1986

SUB	1	2	3	4	5	6
DA (AC)	1335	894	1104	1634	1269	529
mi²	2.09	1.4	1.72	2.55	1.98	0.83
Hyd Length	13377	7500	12,800	19,700	10,800	9780
SLOPE	0.0253	0.0161	0.0201	0.0211	0.0214	0.0161
Fp Adj	0.73	0.63	0.7	0.62		0.61
SOILS (AC) A	318 232	85 54	118 83	309 192	358	137 84
B	205 150	203 128	310 217	241 149	116	66 40
C	701 512	548 345	628 440	897 556	686	135 82
D	8 6	35 22	28 20	144 89	98	39 24
A/D	30 22	8 5		43 27	11	67 41
Wetlands	15	55	58	111	1.1	60
Ponds	4 + 37	51		107		4
TOTAL	1262	879	1084	1634	1269	444
% Wet	56/1262 4.4 %	106/879 12 %	58/1084 5.3%	218/1634 13.3%	—	64/444 14.4 %
Fp	0.73	0.63	0.70	0.62	1.0	0.61
Adj Area	921		759	1013		

50yr 24hr Rainfall

Type III Storm



Taylor River Dam #106.08 12-1-04 GSL

REACH	1	2	3	4
LENGTH	5900	4700	19,850	6300
ELEV UP	16.0	20.0	149.0	39.0
ELEV DOWN	8.0	16.0	20.0	16.0

Dam #106.13

HT = 5'

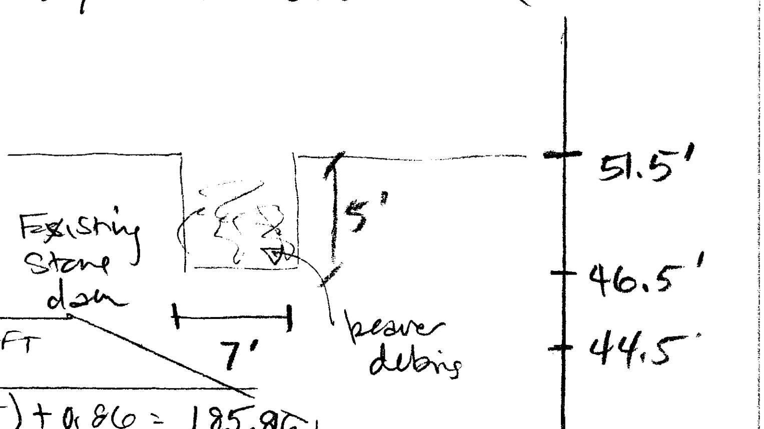
SA = 1.3AC

Q_{10} = 225cfs

Proposed dam → 7' high - 37Ac pond
never built - plans submitted in 1986

There is a beaver dam at the site of an old stone dam u/s of Drinkwater Rd (Curtis)

24" culvert under road



STORAGE	ELEV	SA	Ac-FT
MAX	51.5	37	37(5) + 0.86 = 185.86
P&FM	46.5	1.3	0.33(2) 1.3 = 0.86
BOT	44.5		

Car Barn Pond Dam # 105.01 11-24-04 GEL

ARCVIEW

LINSP 8/30/96

Old River

d/s of Rte 101 ©

DA = 1.8 mi^2

SA = 3.7 Ac 2.7 Ac

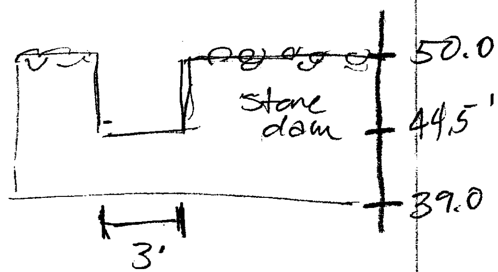
HT = 11 ft

LENGTH = 180 ft

Q_{50} = 70 cfs (USGS & NEHC)

OUTLETS

1 - 3'w x 5.5'h stop log bay



STORAGE	ELEV	SA	AC-FT	
MAX	50	3.7	5.5(3.7) + 4.46 = 24.8	
PERM	44.5	2.7	0.33(5.0)2.7 = 4.46	
BOT	39.0	0		

Taylor River Pond Dam #106.06 — 11-24-04 GSC

	FILE	REVIEW
DA =	9.75 mi²	8.47 mi²
HT =	14 ft	
LENGTH =	125 ft	
SA =	6.3 AC	6.3 AC

Wasta10.apr

AO issued 10/28/92

COD issued 6/3/98

Q50 = 903 cfs
432 cfs → Potters

Qdisch = 2165 cfs

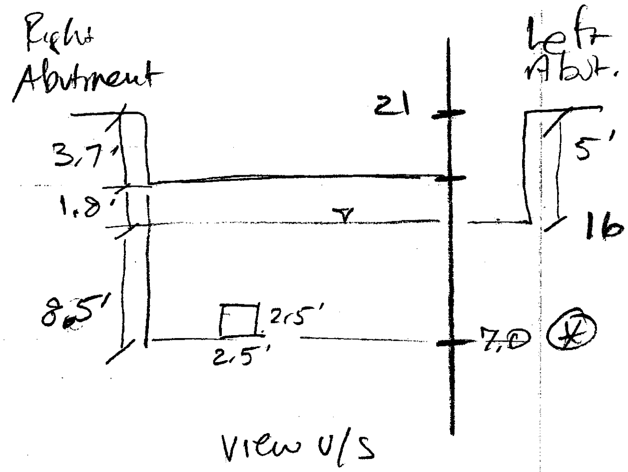
HydroCAD ver 6.0
492 cfs in
463 cfs out
pk elev = 18.17'

OUTLETS

1 - 52' w x 5' h spillway

1 - 10' w x 3.7' h spillway

1 - 2.5' x 2.5' low level gate



STORAGE	ELEV	SA	AC-FT	FILE
MAX	21	10	10(5) + 18.7 = 68.7	60.8
PERM	16	6.3	0.33(9) 6.3 = 18.7	20.8
BOT	7	0		

Brown Rd
D/S Bridge 250' d/s 2 - 12' w x 12.5' h openings
INV = 14'

(*) BA = 6.5 m USGS map = 21.3'

Taylor River Road Dike # 106.09 GEL 12-7-04

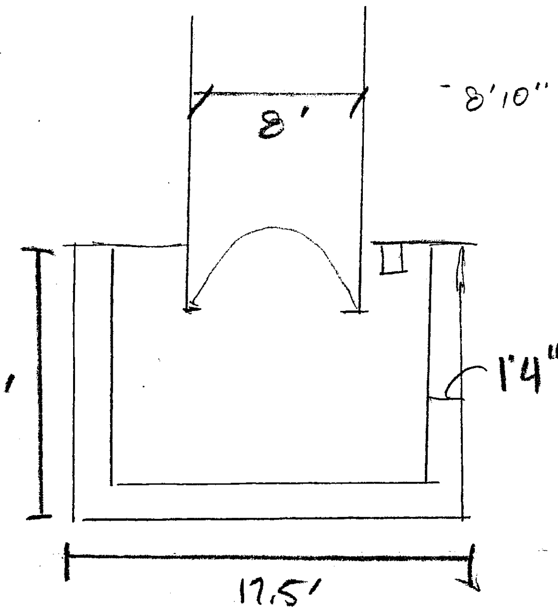
Relief Structure for #106.08

Emergency Spillway

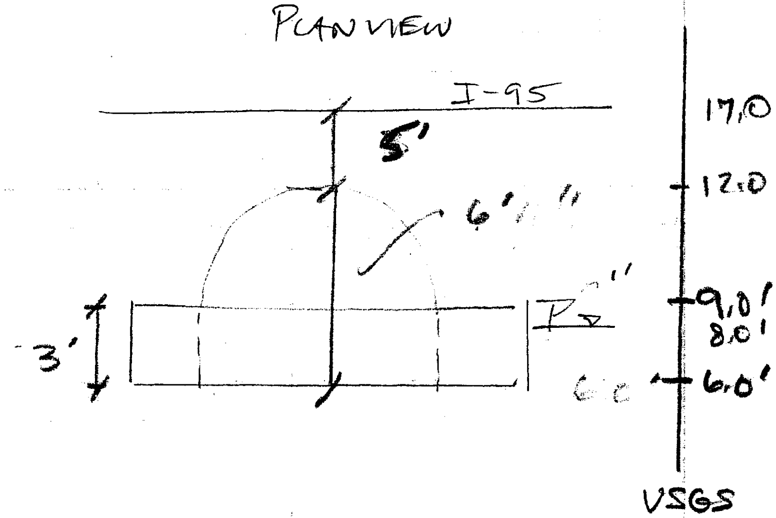
<u>Outlets</u>

1- 39.5' long weir x 1.5' wide

Q discharge = 506 cfs



PLAN VIEW



Pond 1P: Taylor Pond Dam #106.08

[61] Hint: Submerged 53% of Reach 1R bottom

Inflow	=	805.89 cfs @	17.19 hrs, Volume=	313.540 af
Outflow	=	540.32 cfs @	20.00 hrs, Volume=	121.430 af, Atten= 33%, Lag= 168.4 min
Primary	=	540.32 cfs @	20.00 hrs, Volume=	121.430 af

100 yr storm
Run
w/ no
emergency
spillway

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Starting Elev= 8.00' Storage= 98.000 af
Peak Elev= 12.26' Storage= 289.758 af (191.758 af above starting storage)
Flood Elev= 17.00' Storage= 503.000 af (405.000 af above starting storage)
Plug-Flow detention time= 306.2 min calculated for 23.430 af (7% of inflow)

top of
se95

Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
8.00	98.000
17.00	503.000

Primary OutFlow (Free Discharge)
1=Culvert
2=Broad-Crested Rectangular Weir
3=Broad-Crested Rectangular Weir

#	Routing	Invert	Outlet Devices
1	Primary	0.50'	**15.00' x 10.00' x 100.0' long Culvert** Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 0.00' S= 0.0050 '/' n= 0.013 Cc= 0.900
2	Device 1	8.00'	**15.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
3	Device 1	8.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

100yr storm

Pond 1P: Taylor Pond Dam #106.08

[61] Hint: Submerged 50% of Reach 1R bottom

Inflow	=	805.89 cfs @	17.19 hrs,	Volume=	313.540 af	
Outflow	=	580.98 cfs @	20.00 hrs,	Volume=	132.399 af,	Atten= 28%, Lag= 168.4 min
Primary	=	495.01 cfs @	20.00 hrs,	Volume=	115.733 af	
Secondary	=	85.97 cfs @	20.00 hrs,	Volume=	16.666 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Starting Elev= 8.00' Storage= 98.000 af
Peak Elev= 12.02' Storage= 278.872 af (180.872 af above starting storage)
Flood Elev= 17.00' Storage= 503.000 af (405.000 af above starting storage)
Plug-Flow detention time= 288.4 min calculated for 34.285 af (11% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
8.00	98.000
17.00	503.000

Primary OutFlow (Free Discharge)
└─1=Culvert
  ├─2=Broad-Crested Rectangular Weir
  └─3=Broad-Crested Rectangular Weir

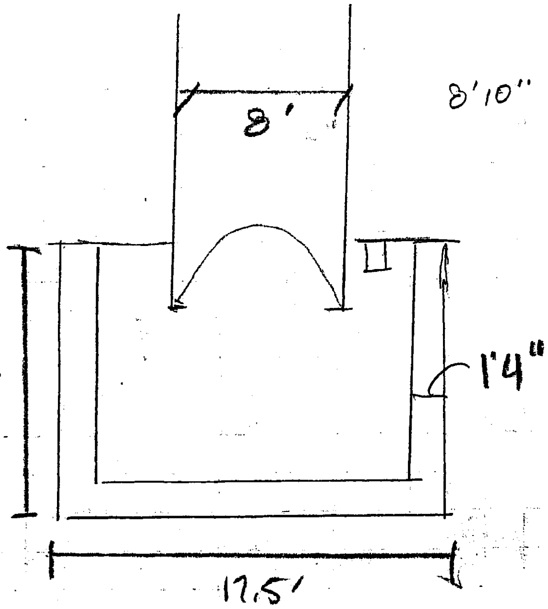
Secondary OutFlow (Free Discharge)
└─4=Culvert

#	Routing	Invert	Outlet Devices
1	Primary	0.50'	**15.00' x 10.00' x 100.0' long Culvert** Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 0.00' S= 0.0050 '/' n= 0.013 Cc= 0.900
2	Device 1	8.00'	**15.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
3	Device 1	8.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
4	Secondary	9.00'	**8.00' x 6.00' x 100.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8.95' S= 0.0005 '/' n= 0.015 Cc= 0.900

Taylor River Pond Dike # 106.09 GEL 12-1-04

Relief Structure for #106.08

Emergency Spillway

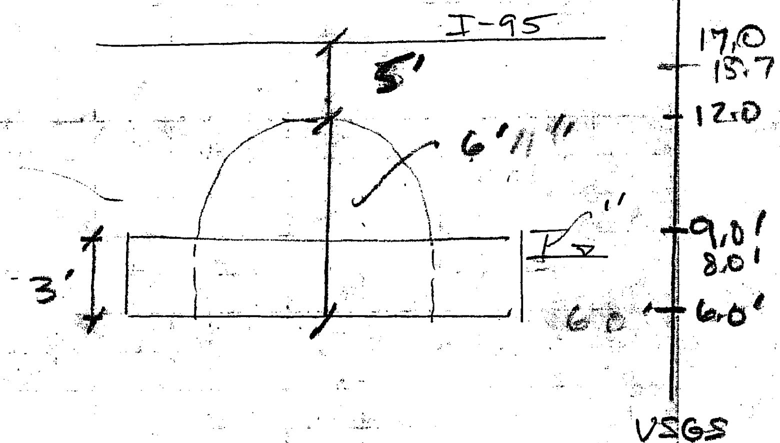


PLAN VIEW

Outlets

1 - 35.5' long weir x 1.5' wide

Q discharge = 506 cfs



1974 Plans show top of road = 15.7'

Pond 1P: Taylor Pond Dam #106.08

Inflow = 625.75 cfs @ 17.32 hrs, Volume= 236.893 af
Outflow = 418.33 cfs @ 20.00 hrs, Volume= 89.537 af, Atten= 33%, Lag= 160.9 min
Primary = 363.12 cfs @ 20.00 hrs, Volume= 80.075 af
Secondary = 55.21 cfs @ 20.00 hrs, Volume= 9.462 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Starting Elev= 8.00' Storage= 98.000 af
Peak Elev= 11.27' Storage= 245.112 af (147.112 af above starting storage)
Flood Elev= 17.00' Storage= 503.000 af (405.000 af above starting storage)
Plug-Flow detention time= (not calculated)

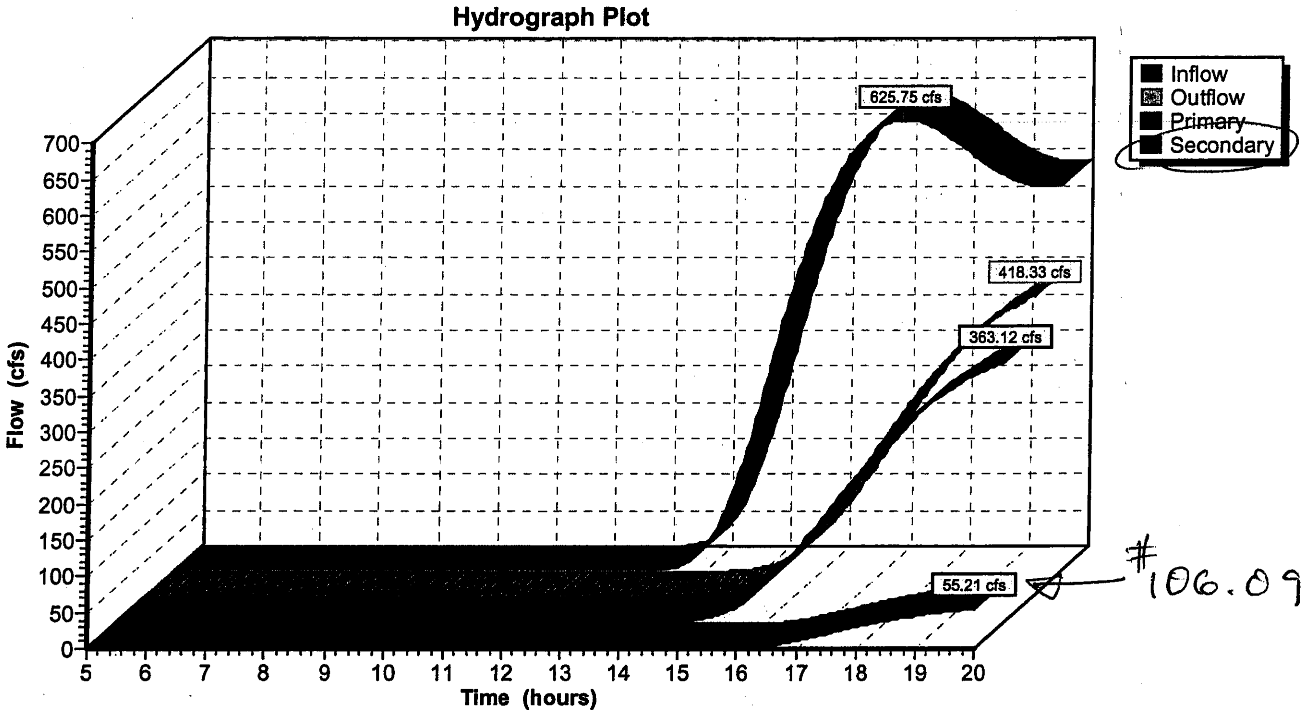
Elevation (feet)	Cum.Store (acre-feet)
0.00	0.000
8.00	98.000
17.00	503.000

Primary OutFlow (Free Discharge)
└─1=Culvert
  ├─2=Broad-Crested Rectangular Weir
  └─3=Broad-Crested Rectangular Weir

Secondary OutFlow (Free Discharge) #106.09
└─4=Culvert

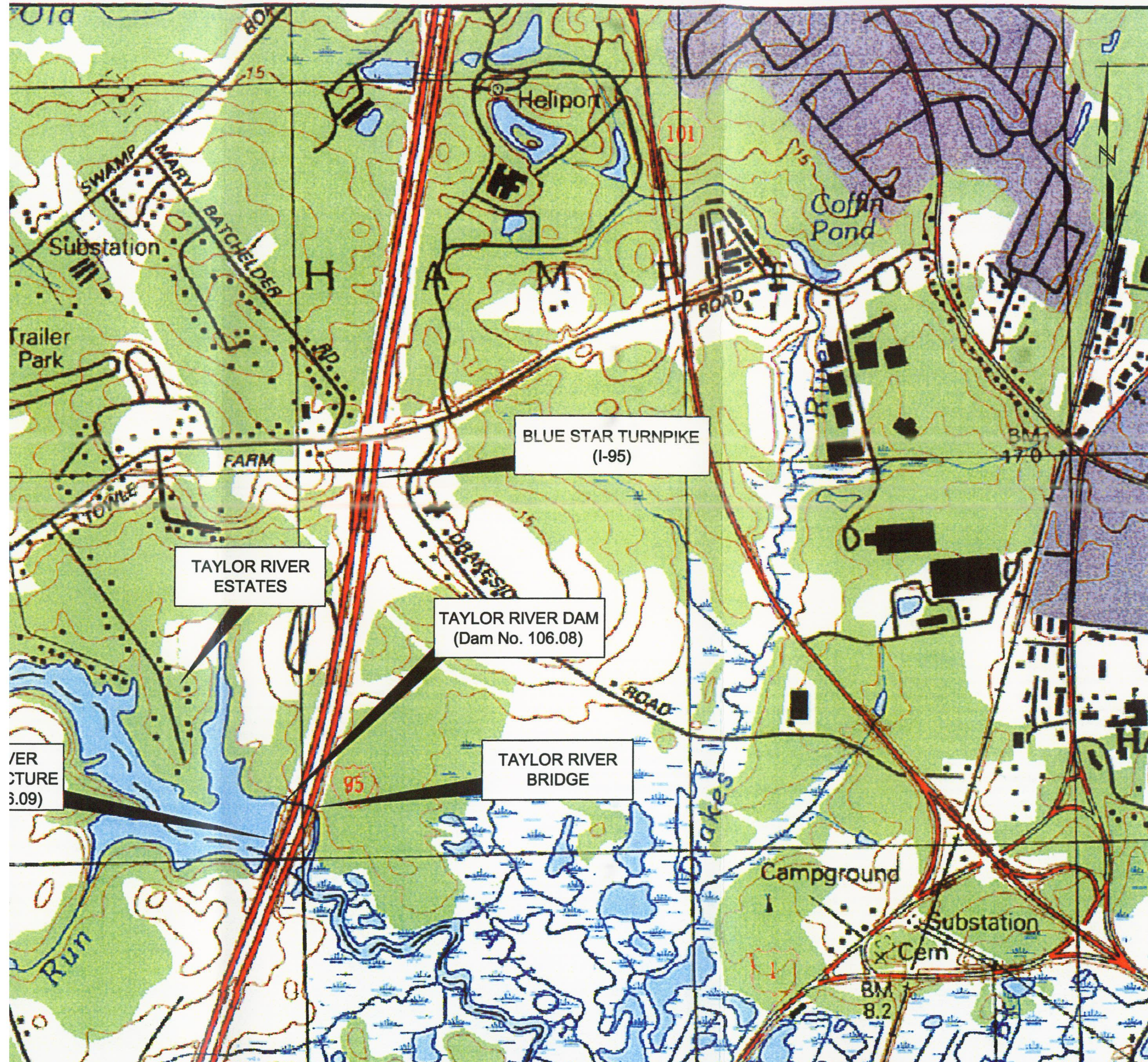
#	Routing	Invert	Outlet Devices
1	Primary	0.50'	**15.00' x 10.00' x 100.0' long Culvert** Box, headwall w/3 square edges, Ke= 0.500 Outlet Invert= 0.00' S= 0.0050 '/' n= 0.013 Cc= 0.900
2	Device 1	8.00'	**15.5' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
3	Device 1	8.00'	**3.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32
4	Secondary	9.00'	**8.00' x 6.00' x 100.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900 Outlet Invert= 8.95' S= 0.0005 '/' n= 0.015 Cc= 0.900

Pond 1P: Taylor Pond Dam #106.08



Pond 1P: Taylor Pond Dam #106.08

Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)	Elevation (feet)	Discharge (cfs)	Primary (cfs)	Secondary (cfs)
0.00	0.00	0.00	0.00	10.40	254.11	228.36	25.75
0.20	0.00	0.00	0.00	10.60	289.35	257.50	31.85
0.40	0.00	0.00	0.00	10.80	326.14	287.77	38.37
0.60	0.00	0.00	0.00	11.00	364.44	319.15	45.29
0.80	0.00	0.00	0.00	11.20	404.17	351.59	52.58
1.00	0.00	0.00	0.00	11.40	445.28	385.06	60.22
1.20	0.00	0.00	0.00	11.60	487.72	419.53	68.19
1.40	0.00	0.00	0.00	11.80	531.46	454.97	76.49
1.60	0.00	0.00	0.00	12.00	576.46	491.36	85.10
1.80	0.00	0.00	0.00	12.20	622.67	528.67	94.00
2.00	0.00	0.00	0.00	12.40	670.07	566.88	103.20
2.20	0.00	0.00	0.00	12.60	718.63	605.96	112.67
2.40	0.00	0.00	0.00	12.80	768.32	645.91	122.42
2.60	0.00	0.00	0.00	13.00	819.12	686.70	132.42
2.80	0.00	0.00	0.00	13.20	871.00	728.31	142.69
3.00	0.00	0.00	0.00	13.40	923.93	770.73	153.21
3.20	0.00	0.00	0.00	13.60	977.91	813.94	163.97
3.40	0.00	0.00	0.00	13.80	1,032.90	857.93	174.97
3.60	0.00	0.00	0.00	14.00	1,088.89	902.69	186.21
3.80	0.00	0.00	0.00	14.20	1,145.87	948.19	197.67
4.00	0.00	0.00	0.00	14.40	1,203.80	994.44	209.36
4.20	0.00	0.00	0.00	14.60	1,262.69	1,041.42	221.27
4.40	0.00	0.00	0.00	14.80	1,322.51	1,089.11	233.40
4.60	0.00	0.00	0.00	15.00	1,383.25	1,137.51	245.74
4.80	0.00	0.00	0.00	15.20	1,444.90	1,186.61	258.29
5.00	0.00	0.00	0.00	15.40	1,507.44	1,236.40	271.04
5.20	0.00	0.00	0.00	15.60	1,570.86	1,286.86	284.00
5.40	0.00	0.00	0.00	15.80	1,635.15	1,337.99	297.16
5.60	0.00	0.00	0.00	16.00	1,700.29	1,389.78	310.51
5.80	0.00	0.00	0.00	16.20	1,766.28	1,442.22	324.06
6.00	0.00	0.00	0.00	16.40	1,833.10	1,495.30	337.80
6.20	0.00	0.00	0.00	16.60	1,900.74	1,549.02	351.72
6.40	0.00	0.00	0.00	16.80	1,969.20	1,603.37	365.83
6.60	0.00	0.00	0.00	17.00	**2,038.47**	**1,658.34**	**380.13** # 106.09
6.80	0.00	0.00	0.00				
7.00	0.00	0.00	0.00				
7.20	0.00	0.00	0.00				
7.40	0.00	0.00	0.00				
7.60	0.00	0.00	0.00				
7.80	0.00	0.00	0.00				
8.00	0.00	0.00	0.00				
8.20	4.63	4.63	0.00				
8.40	13.67	13.67	0.00				
8.60	26.48	26.48	0.00				
8.80	43.68	43.68	0.00				
9.00	61.42	61.42	0.00				
9.20	81.68	80.74	0.94				
9.40	104.92	101.74	3.18				
9.60	130.69	124.31	6.38				
9.80	158.67	148.33	10.34				
10.00	188.66	173.72	14.94				
10.20	220.52	200.42	20.10				



0 1000 2000

APPROXIMATE SCALE, FEET

Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

The Louis Berger Group
Manchester, New Hampshire

GEI Consultants

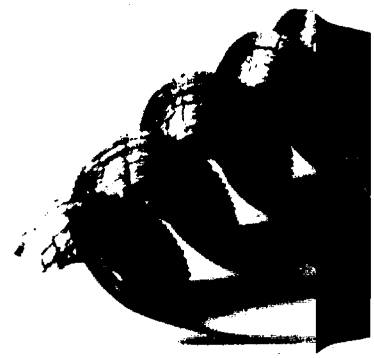
SITE VICINITY MAP

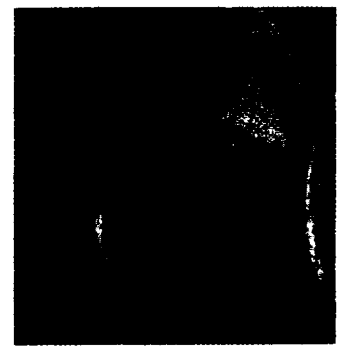
Project 06400-0 | March 2007 | Fig. 1

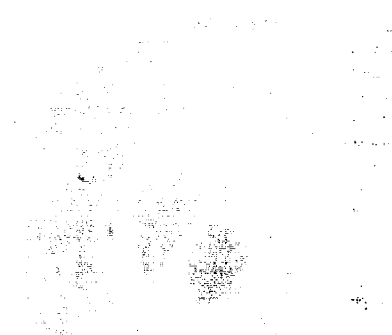
064000-01 djm/ptc 3/23/07

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering







Appendix A

Published Geological Information

Table A1. Description of the Kittery Formation
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

This sedimentary unit was first named the Kittery Quartzite by Katz (1917) from the excellent exposures to be seen along the Piscataqua River in Kittery, Maine. Here he estimated the thickness of the formation to be 1500 feet. Because of the diversity of rock types present within the unit, Novotny (1963) proposed that the name be changed to Kittery Formation. In New Hampshire abundant exposures are to be seen along the Piscataqua River opposite the type area, along the western shore of Great and Little Bays, and along Interstate 95 which traverses the entire length of the major belt of the Kittery Formation in New Hampshire. A second belt, now largely displaced by the Exeter pluton, consists of four separate remnants which now flank the pluton (Plate 1).

In the field most outcrops of the Kittery Formation show gray, brownish-gray or dark green, fine-grained, banded, impure quartzite. Technically, the use of the term quartzite for a significant portion of the Kittery Formation may well be questioned (Lyons, John B., Personal communication). Modal analyses by Novotny (Table 3, Appendix) and in southwestern Maine by Woodard (1968) indicate that the lighter beds of the formation might well be termed fine-grained, lime-silicate granofels. However, as the association of the term quartzite with the formation is widespread, the questioned portion is considered as impure quartzite in this report. This type of rock is often interbedded with slate, phyllite, or fine-grained schist. As the latter rocks decompose and disintegrate more rapidly than the quartzite, a false impression is often gained that the formation consists almost entirely of quartzite. A characteristic of the quartzitic portions of the formation relates to jointing. A number of sets of joints and incipient fractures criss-cross the brittle quartzite. These rarely intersect near right angles, as is common in many rocks. A result of this unusual jointing is the production of distinctive, highly irregular and angular fragments as the rock disintegrates.

Banding in the impure quartzite horizons resembles that of varved clays and silts of glacial areas. Seasonal banding is indicated (Plate 11A). At this time, however, there is no evidence, other than appearance, to support a relationship to glaciation. Chemical analyses of the light and dark bands are given by Billings and Wilson (1964).

Detailed information of the various rock types in the Kittery Formation, with the mineral content of each, is given in Table 3, Appendix.

From Novotny, 1969 (Reference 9)

Table A2. Description of Surficial Geology Map Units
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

Adapted from Goldsmith, 2001 (Reference 3).

DESCRIPTION OF MAP UNITS

A thin layer of windblown sand and silt generally less than 3 ft (l m) thick covers much of the map area but is not shown. The lower part of this layer is generally mixed with underlying surficial deposits.

af	**Artificial Fill (Holocene).** Earth-fill material in road and railroad embankments and made land. Many small bodies not shown on map.
Qal	**Alluvium (Holocene).** Sand, silt, and minor gravel in flood plains along present-day rivers and streams. As much as 20 ft (7 m) thick and underlain by adjacent deposits. Extent of alluvium indicates most areas flooded in the past which may be subject to future flooding.
Qw	**Fresh Water Wetlands Deposits [Swamp Deposits] (Holocene).** Partially decomposed organic material (peat), silt, and sand underlying poorly drained areas. Generally 5 to 15 ft (2-5 m) thick.
Qsm	**Salt March Deposits (Holocene).** Partly decomposed organic material mixed or interbedded with estuarine silt, clay, and sand. Five to 20 ft (2-6 m) thick.
Qmw	**Wave-Formed Deposits (Pleistocene).** Sand and Gravel derived from till deposits by reworking of the sea. Some wave-formed deposits occur on other till and glaciomarine deposits but are too small to map.

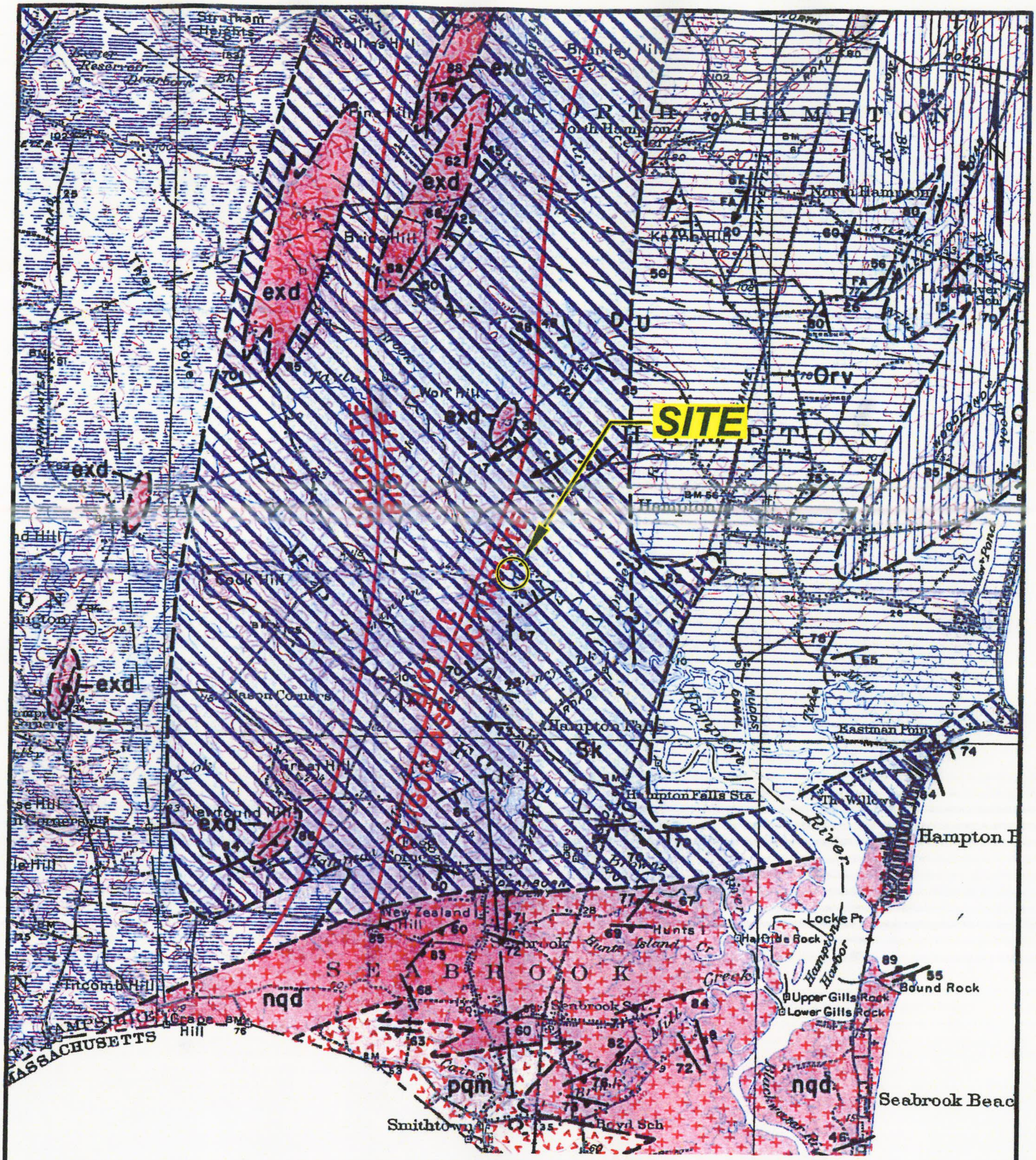
GLACIOMARINE DEPOSITE (PLEISTOCENE).

Sand, gravel, silt and clay, poorly to well stratified. Deposited in or graded to the synglacial sea by meltwater streams at and beyond ice-marginal positions of the retreating ice sheet. Sea level ranged from about 110 ft (33.5 m) altitude in the southeast corner of the map area to about 150 ft (45.7 m) in the northwestern part. Ice marginal deposits are mostly deltaic, composed of sand and gravel and mark successive ice-retreat positions. Deposits laid down on the sea bottom beyond the deltas consist of sand, clay, and silt of the Presumpscot Formation.

Qps	**Presumpscot Formation.** Composed of two facies, Qps and Qpc. Qps: Sand, fine to coarse, locally contains small pebbles, may contain thin beds of silt and clayey silt. Thickness generally less than 20 ft (6.1 m) thick but may be as much as 30 ft (9.1 m).
Qpc	Qpc: Clayey silt or silty clay, locally contains silt and fine sand beds. Thickness as much as 55 ft (16.7).
	Qps intertongues laterally and downward with Qpc.
Qmwd	**Wave-Modified Marine Delta Deposits.**

TILL (PLEISTOCENE).

Qt	**Till.** Non-sorted to poorly sorted mixture of clay, silt, sand, pebbles, cobbles, and boulders; dominant grain size is silt or to small pebbles; locally contains small irregular masses of sand and gravel. Deposited directly by the ice sheet. Thickness is variable, thin, 5 to 15 ft (1.5-4.6 m) thick, but as much as 100 ft (30.5 m) under the crests of drumlins. Locally – clayey, a source for clay.
Qtt	**Thin Till.**



Note:

For Legend see Figure A2.

Reference:

From Novotny, 1969 (Reference 9)

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	BEDROCK GEOLOGY MAP
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. A1

064000-06 djm/ptc 3/23/07

IGNEOUS ROCKS

Late Devonian? — Hillsboro Plutonic Series — DEVONIAN ?

qm

Quartz monzonite

Medium- to coarse-grained, massive, light-gray to buff quartz monzonite, composed chiefly of oligoclase, microcline, microcline-microperthite, and quartz.

exd

Exeter diorite

Light-gray to black, fine- to coarse-grained, massive diorite, quartz diorite, gabbro, and quartz monzonite, composed chiefly of oligoclase, andesine, or labradorite, hypersthene or augite, hornblende, biotite, and microcline.

pqm

Porphyritic quartz monzonite

Medium- to coarse-grained, porphyritic, medium-gray, moderately- to well-foliated quartz monzonite, composed chiefly of microcline phenocrysts and hornblende, biotite, and chlorite.

nqd

Newburyport quartz diorite

Medium- to coarse-grained, well-foliated, medium-gray quartz diorite, composed of oligoclase or andesine, quartz, hornblende, biotite, and chlorite.

gr

Granite and pegmatite

Medium- to coarse-grained, white to tan, massive to well-foliated granite and pegmatite, composed of quartz, microcline, oligoclase, and muscovite, with minor garnet, tourmaline, and biotite.

METAMORPHIC ROCKS

Lower Devonian — DEVONIAN

Dl

Littleton formation

Medium- to coarse-grained, well-foliated, thin-bedded, silvery gray, quartz-staurolite-mica schist, quartz-staurolite-garnet-mica schist, with porphyroblasts of staurolite and garnet.

Middle Silurian? — SILURIAN ?

Sb

Berwick formation

Fine- to medium-grained, thin-bedded to massive, light- to dark-gray or black feldspathic quartz-biotite schist, biotite-quartz-sericite schist, and quartz-sericite schist: fine- to medium-grained, light-gray to light gray-green, thin to thick beds and lenses of lime-silicate rock, containing oligoclase-andesine, actinolite, diopside, garnet, epidote-zoisite, calcite, and biotite: minor beds of feldspathic quartzite.

Se

Eliot formation

Dark-gray slate: dark-gray to dark-green phyllite, commonly dolomitic: light- to dark-gray to black biotite schist, quartz-biotite schist, and feldspathic quartz-biotite schist; massive, light-gray to light gray-green, fine-grained quartzite, in part feldspathic, in part dolomitic; light gray-green to brown, fine- to medium-grained, lime-silicate rock, containing actinolite.

Sk

Kittery formation

Dark-gray slate; dark gray-green to silvery gray phyllite; fine- to medium-grained, finely-laminated to massive, poorly- to well-foliated quartz-biotite schist, biotite-sericite schist, and feldspathic quartz-biotite schist, commonly calcareous and actinolitic; light gray-green to dark-gray, well-bedded to massive, fine-grained quartzite and feldspathic quartzite; thin-bedded to massive, medium-grained, light-gray to light gray-green lime-silicate rock.

ORDOVICIAN?

Orv
Orm

Rye formation

Upper metavolcanic member: Orv — dark-gray, medium- to coarse-grained, foliated quartz-biotite-plagioclase gneiss, finely interlaminated fine-grained, maroon feldspathic quartz-biotite schist and fine-grained gray-green feldspathic quartz-actinolite schist; medium- to coarse-grained, dark-gray biotitic or hornblendic injection and permeation gneiss; dark-green to black, fine- to coarse-grained amphibolite and hornblende schist; minor fine-grained gray quartzite.

Lower metasedimentary member: Orm — fine- to coarse-grained, light- to dark-gray and black mica schist and quartzo-feldspathic schist, commonly containing garnet and sillimanite; fine- to medium-grained, thin-bedded to massive, gray quartzite, commonly feldspathic and garnetiferous; fine- to coarse-gained, dark-green to black amphibolite, commonly containing diopside and garnet.

METAMORPHIC ZONES

Indicated by key minerals and separated by isograds
Chlorite zone
Biotite zone
Oligoclase-actinolite zone
Sillimanite zone

CONTACTS

Approximate — Projected

FAULTS

U
D

Dashed where approximate; queried where doubtful
U: Upthrown side
D: Downthrown side

STRUCTURAL SYMBOLS

60 Inclined — Vertical
Strike and dip of bedding

70 Inclined — Vertical
Strike and dip of foliation in metamorphic and plutonic rocks

50 Inclined — Vertical
Strike and dip of cleavage

Inclined — Vertical
Strike and dip of joints

15
Bearing and plunge of minor structures
FA: Small fold axes
M: Mineral alignment
C: Crinkles or corrugations
CB: Cleavage-bedding intersections

QUARRIES

Operating — Abandoned

Reference:

From Novotny, 1969 (Reference 9)

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	BEDROCK GEOLOGY EXPLANATION	
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007	Fig. A2

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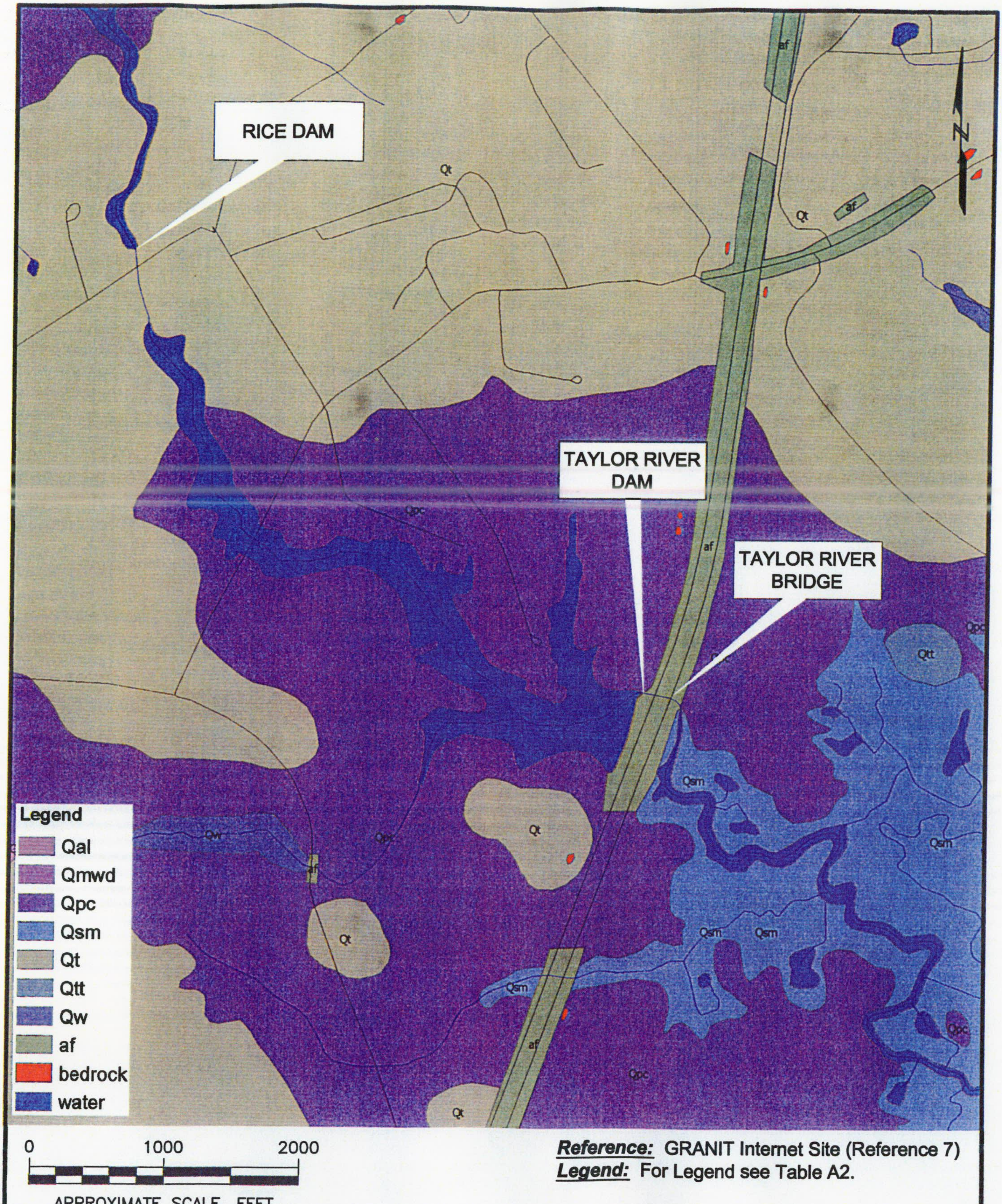


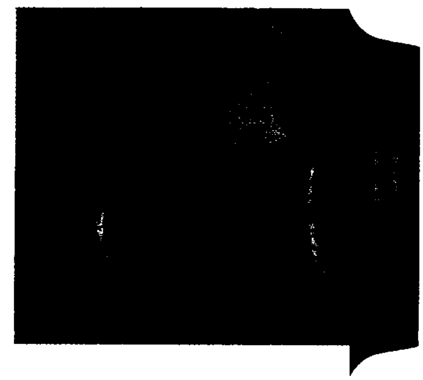
Reference: GRANIT Internet Site (Reference 7)
Legend: For Legend see Table A2.

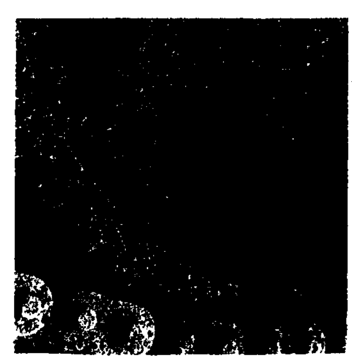
Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	SURFICIAL GEOLOGY
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. A3

064000-04 djm 3/23/07

GEI Consultants

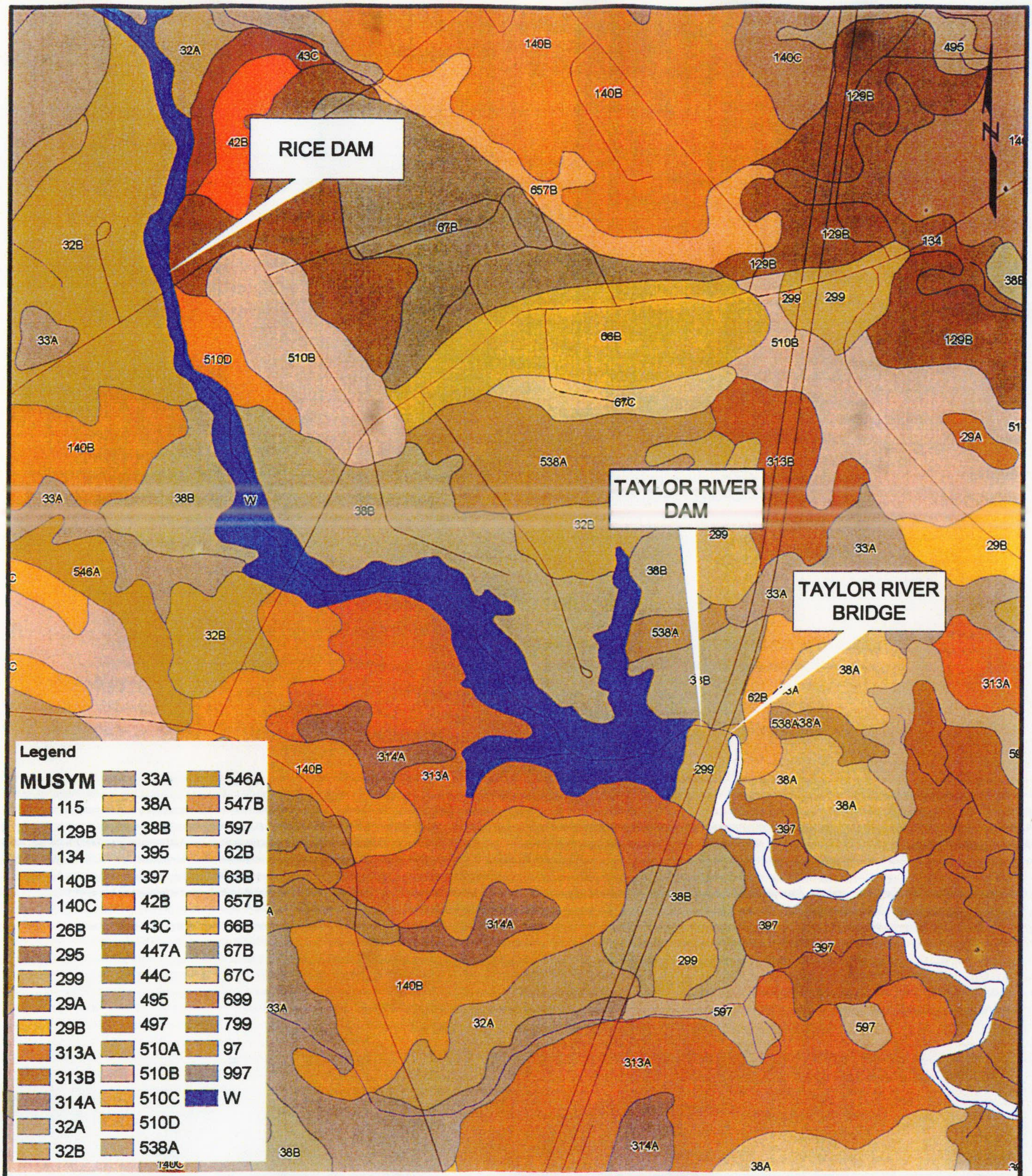
Geotechnical
Environmental and
Water Resources
Engineering

Appendix B

Soil Survey Information



0 1000 2000

APPROXIMATE SCALE, FEET

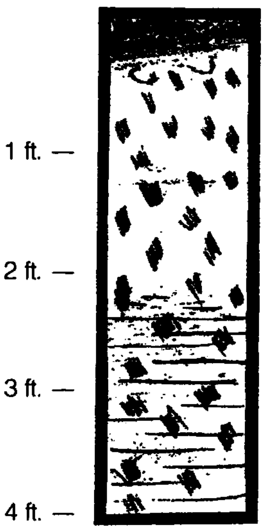
Reference: GRANIT Internet Site (Reference 7)

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	SOIL SURVEY MAP
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. B1

064000-04 djm/ptc 3/23/07

32A—Boxford silt loam, 0 to 3 percent slopes. This nearly level soil is on low, gentle rises on broad plains or on low rises at the base of hills or adjacent to streams. Areas are oval or irregularly shaped and are 4 to 125 acres in size.

A generalized profile of this soil is as follows:



Surface Layer:
dark brown silt loam

Subsoil (upper part):
dark yellowish brown silt loam

Subsoil (lower part):
mottled olive silt loam

Substratum:
mottled olive silty clay

Inclusions make up about 20 percent of the map unit. Among these are Scitico and Squamscott soils in hollows and drainageways and Eldridge soils on scattered low rises throughout the map unit.

Soil features affecting use—

Drainage class: moderately well drained and somewhat poorly drained
Depth to a seasonal high water table: 1 to 3 feet
Depth to bedrock: more than 60 inches
Permeability: slow
Available water capacity: high
Flooding: none
Potential for frost action: high
Shrink-swell potential: moderate

Most areas of this soil are used as woodland. Some areas are used for cultivated crops or forage. In most areas the soil is considered prime farmland.

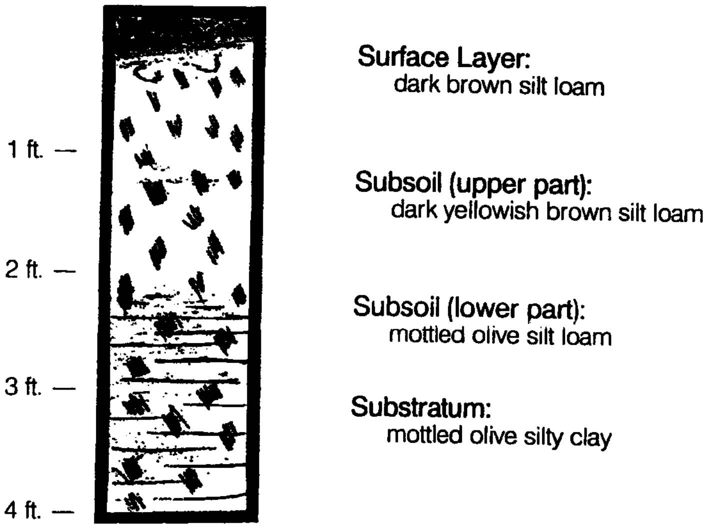
This soil is well suited to cultivated crops and forage species, but it is wet and thaws slowly during the early part of the growing season. The wetness and low soil temperature hamper early planting of the crops that require a long growing season. Because of the restricted permeability, the soil is wet after a heavy rain. Although a subsurface drainage system may not be effective, land grading can reduce the wetness. Early planting should be avoided. Working the soil during wet periods results in the formation of ruts, compaction, and clodding. Grazing of undrained pasture should be delayed until the soil dries out. Frost action is a limitation. Perennial plants that can withstand wetness and frost action should be selected for planting. For example, alfalfa does not grow well on this soil because frost heaving damages the roots. A better choice of perennial forage would be a grass-legume mixture that includes clover.

This soil is well suited to woodland. The most common trees are paper birch, eastern white pine, eastern hemlock, and northern red oak. Areas of this soil can be good sites for white pine and produce high-quality pine sawlogs, but preventing the invasion of hardwoods or hemlock is difficult. For example, after an area has been clearcut, red maple, aspen, or hemlock will reseed rather than white pine. Partial cutting can favor white pine. Shelterwood cutting, in which half of the trees are removed, is not recommended because strong winds may uproot the remaining trees. A better alternative is improvement cutting, in which only a third of the trees are harvested and thus the hazard of windthrow is reduced. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down. Midsummer harvesting can result in little rut formation if the summer has been dry. Because of the restricted permeability, however, a single heavy rainstorm can wet the site enough for machine traffic to cause the formation of deep ruts.

This soil is suited to urban development, but the wetness, the restricted permeability, and frost action are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, though sump pumps may still be needed. Storm water management is critical because of the restricted permeability. Land shaping, ditching, and installing culverts around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy rains. Because of the potential for frost action, foundations should have adequate footings. Properly designing road subgrades can reduce the hazard of frost heaving.

32B—Boxford silt loam, 3 to 8 percent slopes. This gently sloping soil is on low knolls in broad, low areas and on the lower side slopes adjacent to hills. Areas are long and narrow or irregularly shaped and are 4 to 140 acres in size.

A generalized profile of this soil is as follows:



Inclusions make up about 20 percent of the map unit. Among these are Scitico soils in hollows, Eldridge soils in scattered areas throughout the map unit, and soils that have slopes of more than 8 percent or less than 3 percent.

Soil features affecting use—

Drainage class: moderately well drained and somewhat poorly drained
Depth to a seasonal high water table: 1 to 3 feet
Depth to bedrock: more than 60 inches
Permeability: slow
Available water capacity: high
Flooding: none
Potential for frost action: high
Shrink-swell potential: moderate

Most areas of this soil are used as woodland. In most areas the soil is considered additional farmland of statewide importance.

This soil is well suited to cultivated crops and forage species. Because of the slope, however, erosion is a hazard. In areas used for corn silage, this hazard can be reduced by no-till farming and other forms of conservation tillage or by short rotations, such as 2 years of corn and 5 years of hay. In areas where row crops, such as vegetables, are grown year after year, diversions and terraces may be needed as erosion-control measures. The soil is wet and thaws slowly during the early part of the growing season. The wetness and low soil temperature hamper early planting of the crops that require a long growing season. Because of the restricted permeability, the soil is wet after a heavy rain. Although a subsurface drainage system may not be effective, land grading can reduce the wetness. Early planting should be avoided. Working the soil during wet periods results in the formation of ruts, compaction, and clodding. Grazing of undrained pasture should be delayed until the soil dries out. Frost action is a limitation. Perennial plants that can withstand wetness and frost action should be selected for planting. For example, alfalfa does not grow well on this soil because frost heaving damages the roots. A better choice of perennial forage would be a grass-legume mixture that includes clover.

This soil is well suited to woodland. The most common trees are paper birch, eastern white pine, eastern hemlock, and northern red oak. Areas of this soil can be good sites for white pine and produce high-quality pine sawlogs, but preventing the invasion of hardwoods or hemlock is difficult. For example, after an area has been clearcut, red maple, aspen, or hemlock will reseed rather than white pine. Partial cutting can favor white pine. Shelterwood cutting, in which half of the trees are removed, is not recommended because strong winds may uproot the remaining trees. A better alternative is improvement cutting, in which only a third of the trees are harvested and thus the hazard of windthrow is reduced. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down. Midsummer harvesting can result in little rut formation if the summer has been dry. Because of the restricted permeability, however, a single heavy rainstorm can wet the site enough for machine traffic to cause the formation of deep ruts.

This soil is suited to urban development, but the wetness, the restricted permeability, and frost action are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, though sump pumps may still be needed. Storm water management is critical because of the restricted permeability. Land shaping, ditching, and installing culverts around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy rains. Because of the potential for frost action, foundations should have adequate footings. Properly designing road subgrades

can reduce the hazard of frost heaving. Because of the slope, erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover.

Erosion is a factor in the management of storm water. Riprap, catch basins, a good plant cover, and diversions can control the runoff of storm water.

33A—Scitico silt loam, 0 to 5 percent slopes. This nearly level and gently sloping soil is on broad, low plains and in drainageways. Areas are long and narrow or irregularly shaped and are 4 to 400 acres in size.

A generalized profile of this soil is as follows:

1 ft. —
2 ft. —
3 ft. —
4 ft. —

Surface Layer:
very dark grayish brown silt loam

Subsoil:
mottled olive gray silty clay loam

Substratum:
mottled dark gray silty clay

In some areas the part of the substratum below a depth of 36 inches is more olive.

Inclusions make up about 15 percent of the map unit. Among these are Maybid soils in hollows and drainageways, Squamscott soils on low rises near the margins of the map unit, and Boxford soils on knolls.

Soil features affecting use—

Drainage class: poorly drained
Depth to a seasonal high water table: 0 to 1 foot
Depth to bedrock: more than 60 inches
Permeability: slow
Available water capacity: high
Flooding: none
Potential for frost action: high
Shrink-swell potential: moderate

Most areas of this soil are used as woodland. In some areas the soil is classified as wetland.

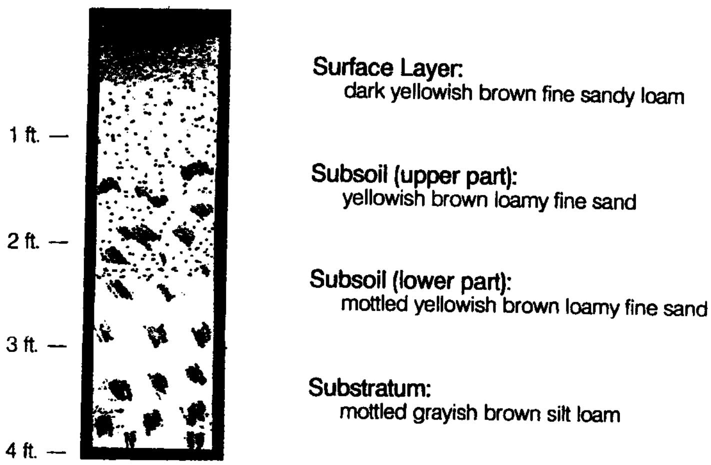
This soil is poorly suited to cultivated crops and forage species. It is wet and thaws slowly in spring. The wetness and low soil temperature hamper early planting of the crops that require a long growing season. Because of the restricted permeability, the soil is wet after a heavy rain. Although a subsurface drainage system may not be effective, bedding systems and land grading can reduce the wetness. Early planting should be avoided, and grazing of undrained pasture should be delayed until the soil dries out. Working the soil during wet periods results in the formation of ruts, compaction, and clodding. Frost action is a limitation. Perennial plants that can withstand wetness and frost action should be selected for planting. For example, alfalfa does not grow well on this soil because frost heaving damages the roots. A better choice of perennial forage would be a grass-legume mixture that includes clover.

This soil is suited to woodland. The most common trees are red maple, eastern white pine, and white ash. The trees are of low quality, though the stands may be densely stocked and yields may be high. The site conditions favor the production of fuelwood. Various species of wildlife are attracted to areas of this soil. In areas managed for fuelwood, scattered ribbon-shaped or kidney-shaped clearcuts should be throughout the lot. The clearcuts should be no more than 200 feet across. The small clearcuts can reduce the hazard of windthrow and provide a varied habitat for wildlife. Harvesting methods that leave a diversity of trees, such as snag trees, trees with cavities, and a variety of size classes, improve the habitat for wildlife. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down. Midsummer harvesting can result in little rutting if the summer has been dry. Because of the restricted permeability, however, a single heavy rainstorm can wet the site enough for machine traffic to cause the formation of deep ruts.

This soil is poorly suited to urban development because of the wetness, ponding, frost action, and the restricted permeability. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, but outlets for the drains are not readily available in some areas. Sump pumps may still be needed. Storm water management is critical because of the restricted permeability. Land shaping, ditching, and installing culverts around the development can help to remove surface water, but ponding may still occur after heavy rains. Because of the potential for frost action, foundations should have adequate footings. Properly designing road subgrades can reduce the hazard of frost heaving.

38B—Eldridge fine sandy loam, 3 to 8 percent slopes. This gently sloping soil is at the base of hills, on low rises in broad drainageways, and on broad plains. Areas are oval or irregularly shaped and are 4 to 200 acres in size.

A generalized profile of this soil is as follows:



In some places depth to the loamy substratum is more than 40 inches. In other places the substratum is more than 18 percent clay.

Inclusions make up about 20 percent of the map unit. Among these are Squamscott and Scitico soils in drainageways, in hollows, and near the margins of the map unit; Boxford soils in scattered areas throughout the map unit; and well drained soils on the tops of knolls.

Soil features affecting use—

Drainage class: moderately well drained
Depth to a seasonal high water table: 1 to 2 feet
Depth to bedrock: more than 60 inches
Permeability: rapid in the upper part of the profile and moderately slow in the lower part
Available water capacity: high
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland. Some areas are used for cultivated crops or forage. In most areas the soil is considered prime farmland.

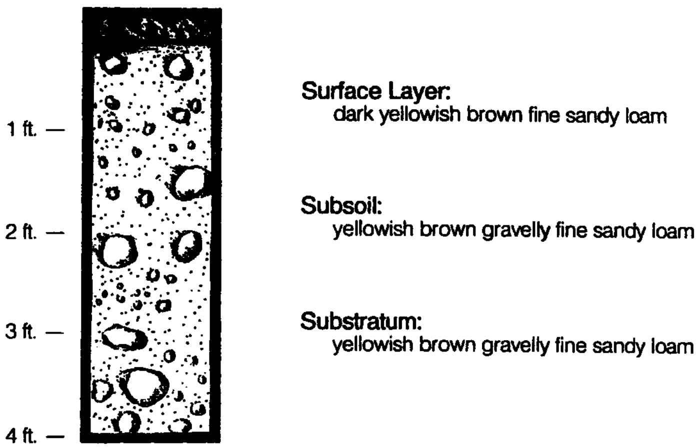
This soil is well suited to cultivated crops and forage species, but it is wet during the early part of the growing season. The wetness hampers early planting of the crops that require a long growing season. Working soil during wet periods results in the formation of ruts and in compaction. If the wetness in areas of cropland is reduced by a subsurface drainage system, the crops can be planted on schedule. Land shaping and grading also can reduce the wetness. Grazing of undrained pasture should be delayed until the soil dries out. Farm machinery should not be used when the soil is wet. Because of the slope, erosion is a hazard. In areas used for corn silage, this hazard can be reduced by no-till farming, chisel plowing, and other forms of conservation tillage or by short rotations, such as 2 years of corn and 5 years of hay. In areas where row crops, such as vegetables, are grown year after year, diversions and terraces may be needed as erosion-control measures.

This soil is well suited to woodland. The most common trees are eastern white pine and northern red oak. Areas of this soil are good sites for white pine and produce high-quality pine sawlogs, but care must be taken to keep hardwoods from invading. For example, after an area has been clearcut, red maple, elm, and other hardwoods will reseed rather than white pine. An alternative that would favor the regeneration of white pine is improvement cutting, in which approximately a third of the trees are harvested. Shelterwood cutting, in which half of the trees are removed, is not recommended because of the hazard of windthrow. Scarifying the surface after the trees are harvested can help the pine seeds to sprout. Stands of white pine respond well to intensive stand improvement measures, such as thinning and pruning. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, or midsummer, when the soil is drier, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down.

This soil is suited to urban development, but the wetness and the restricted permeability are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, though sump pumps may still be needed. Land shaping around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy rains. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover.

62B—Charlton fine sandy loam, 3 to 8 percent slopes. This gently sloping soil is on the tops of ridges, knolls, and low hills. Areas are oval or irregularly shaped and are 4 to 125 acres in size.

A generalized profile of this soil is as follows:



Inclusions make up about 20 percent of the map unit. Among these are Scituate, Newfields, and Woodbridge soils in hollows and adjacent to drainageways; Walpole soils in drainageways; and Canton and Chatfield soils in scattered areas throughout the higher landscape positions.

Soil features affecting use—

Drainage class: well drained
Depth to a seasonal high water table: more than 6 feet
Depth to bedrock: more than 60 inches
Permeability: moderate
Available water capacity: moderate
Flooding: none
Potential for frost action: low
Shrink-swell potential: low

Most areas of this soil are used for cultivated crops or forage. Some areas are used as woodland. In most areas the soil is classified as prime farmland.

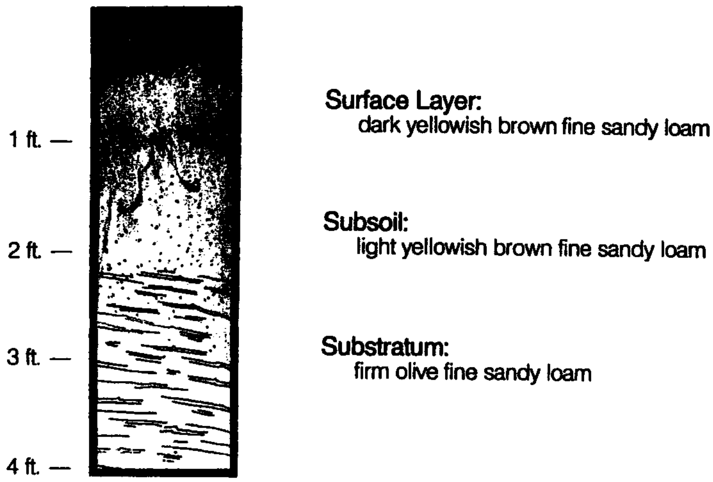
This soil is well suited to cultivated crops and forage species. Because of the slope, however, erosion is a hazard. In areas used for corn silage, this hazard can be reduced by no-till farming and other forms of conservation tillage or by short rotations, such as 2 years of corn and 5 years of hay. In areas where row crops, such as vegetables, are grown year after year, diversions and terraces may be needed as erosion-control measures.

This soil is well suited to woodland. The most common trees are eastern white pine, red pine, sugar maple, shagbark hickory, and northern red oak. Areas of this soil are good sites for the production of sawlogs and lower grade pallet logs from softwoods or hardwoods. Fuelwood can be a by-product of harvesting. Clear-cutting can result in the invasion of lower quality trees. The quality of the trees on the lot can be maintained by partial cutting. For a short period in early spring, the soil is wet and intermittent streams are flowing at full capacity. Harvesting during this peri causes the formation of ruts and the siltation of streams. Also, machines are likely to become bogged down during this period. A better alternative is logging in winter, when the ground and streams are frozen, or in summer and fall, when the soil is drier and the beds of intermittent streams are dry.

This soil is well suited to urban development, but erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover.

66B—Paxton fine sandy loam, 3 to 8 percent slopes. This gently sloping soil is on the tops of smooth, rounded hills that in most places have a northwest orientation. Areas are oval or irregularly shaped and are 4 to 100 acres in size.

A generalized profile of this soil is as follows:



Inclusions make up about 15 percent of the map unit. Among these are Woodbridge soils in hollows and the more nearly level areas and soils that have slopes of less than 3 percent and are on broad hilltops.

Soil features affecting use—

Drainage class: well drained
Depth to a seasonal high water table: 1.5 to 2.5 feet
Depth to bedrock: more than 60 inches
Permeability: moderate in the upper part of the profile and slow in the lower part
Available water capacity: moderate
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used for cultivated crops or forage. Some areas are used as woodland, and some are used for urban development. In most areas the soil is classified as prime farmland.

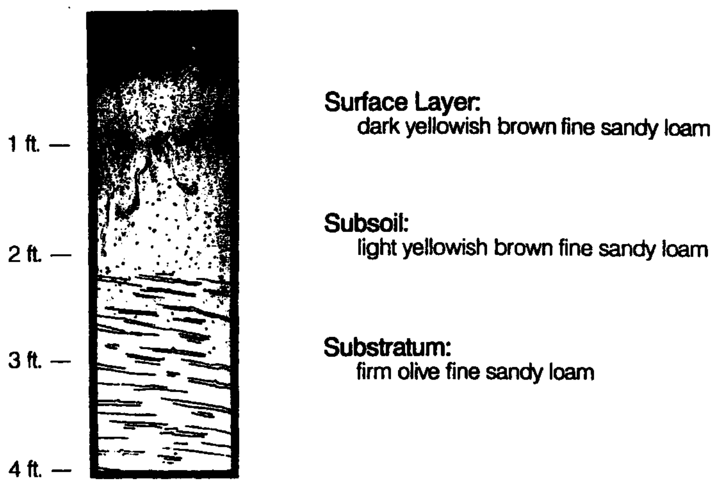
This soil is well suited to cultivated crops and forage species. Because of the slope, however, erosion is a hazard. In areas used for corn silage, this hazard can be reduced by no-till farming and other forms of conservation tillage or by short rotations, such as 2 years of corn and 5 years of hay. In areas where row crops, such as vegetables, are grown year after year, diversions and terraces may be needed as erosion-control measures.

This soil is well suited to woodland. The most common trees are eastern white pine, red pine, sugar maple, and northern red oak. Areas of this soil are good sites for the production of sawlogs and lower grade pallet logs from softwoods or hardwoods. Fuelwood can be a by-product of harvesting. Clear-cutting can result in the invasion of lower quality trees. The quality of the trees on the lot can be maintained by partial cutting. In early spring, the soil is wet and intermittent streams are flowing in full capacity, and in late fall the soil can be wet if the fall rains have been particularly heavy. Harvesting during these periods causes the formation of ruts and the siltation of streams. Also, machines are likely to become bogged down during these periods. A better alternative is logging in midwinter, when the ground and streams are frozen, or in midsummer, when the soil is drier and the beds of intermittent streams are dry.

This soil is well suited to urban development, but the wetness in spring and the restricted permeability are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness in cellars. Land shaping around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy spring rains. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover.

67B—Paxton fine sandy loam, 3 to 8 percent slopes, very stony. This gently sloping soil is on the tops and sides of smooth, rounded hills that in most places have a northwest orientation. Areas are oval or irregularly shaped and are 4 to 100 acres in size. Stones cover 0.01 to 3 percent of the surface.

A generalized profile of this soil is as follows:



Inclusions make up about 15 percent of the map unit. Among these are Woodbridge soils in hollows and the more nearly level areas, soils that have slopes of less than 3 percent and are on broad hilltops, and soils that have slopes of more than 8 percent and are on hillsides. Also included, in the seacoast region, are Canton and Hoosic soils at the base of hills and near the margins of the map unit.

Soil features affecting use—

Drainage class: well drained
Depth to a seasonal high water table: 1.5 to 2.5 feet
Depth to bedrock: more than 60 inches
Permeability: moderate in the upper part of the profile and slow in the lower part
Available water capacity: moderate
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland.

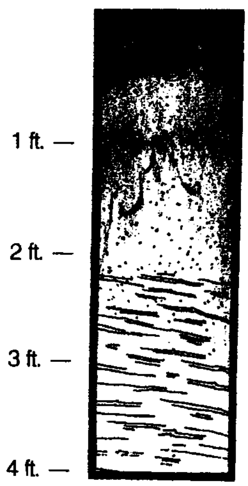
This soil is poorly suited to cultivated crops and forage species because of surface stones. Special machinery, such as stone pickers and bulldozers equipped with rock rakes, is needed to remove the surface stones before cropping can begin.

This soil is well suited to woodland. The most common trees are eastern white pine, red pine, sugar maple, and northern red oak. Areas of this soil are good sites for the production of sawlogs and lower grade pallet logs from softwoods or hardwoods. Fuelwood can be a by-product of harvesting. Clear-cutting can result in the invasion of lower quality trees. The quality of the trees on the lot can be maintained by partial cutting. In early spring, the soil is wet and intermittent streams are flowing at full capacity, and in late fall the soil can be wet if the fall rains have been particularly heavy. Harvesting during these periods causes the formation of ruts and the siltation of streams. Also, machines are likely to become bogged down during these periods. A better alternative is logging in midwinter, when the ground and streams are frozen, or in midsummer, when the soil is drier and the beds of intermittent streams are dry.

This soil is suited to urban development, but the wetness in spring and the restricted permeability are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness in cellars. Land shaping around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy spring rains. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover. Surface stones can hinder landscaping. Once the stones are removed, lawns can be easily established.

67C—Paxton fine sandy loam, 8 to 15 percent slopes, very stony. This strongly sloping soil is on the tops and sides of smooth, rounded hills that in most places have a northwest orientation. Areas are oval or irregularly shaped and are 4 to 150 acres in size. Stones cover 0.01 to 3 percent of the surface.

A generalized profile of this soil is as follows:



Surface Layer:
dark yellowish brown fine sandy loam

Subsoil:
light yellowish brown fine sandy loam

Substratum:
firm olive fine sandy loam

Inclusions make up about 20 percent of the map unit. Among these are Canton and Montauk soils at the base of the hills, Woodbridge soils in hollows, and soils that have slopes of less than 8 percent or more than 15 percent.

Soil features affecting use—

Drainage class: well drained
Depth to a seasonal high water table: 1.5 to 2.5 feet
Depth to bedrock: more than 60 inches
Permeability: moderate in the upper part of the profile and slow in the lower part
Available water capacity: moderate
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland.

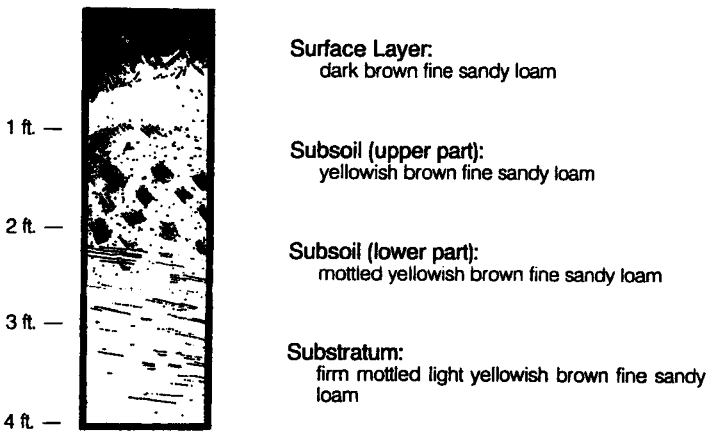
This soil is poorly suited to cultivated crops and forage species because of surface stones. Special machinery, such as stone pickers and bulldozers equipped with rock rakes, is needed to remove the surface stones before cropping can begin. Because of the slope, care is needed in operating some types of farm machinery.

This soil is well suited to woodland. The most common trees are eastern white pine, red pine, sugar maple, and northern red oak. Areas of this soil are good sites for the production of sawlogs and lower grade pallet logs from softwoods or hardwoods. Fuelwood can be a by-product of harvesting. Clear-cutting can result in the invasion of lower quality trees. The quality of the trees on the lot can be maintained by partial cutting. In early spring, the soil is wet and intermittent streams are flowing at full capacity, and in late fall the soil can be wet if the fall rains have been particularly heavy. Harvesting during these periods causes the formation of ruts and the siltation of streams. Also, machines are likely to become bogged down during these periods. A better alternative is logging in midwinter, when the ground and streams are frozen, or in midsummer, when the soil is drier and the beds of intermittent streams are dry. Because of the slope, the main access roads may be subject to erosion. Waterflow can be controlled and the hazard of erosion reduced by a variety of conservation measures, such as water bars, stone fords, culverts, ditches, and a permanent plant cover.

This soil is suited to urban development, but the wetness in spring, the restricted permeability, and the slope are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness in cellars. Land shaping around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy spring rains. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings. Because of the slope, cutting and filling are needed to level sites for septic tank absorption fields. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps, diversions, debris basins, sediment screens, and a good plant cover. If erosion is to be controlled once the development is completed, the design of subdivisions should include adequate management of storm water through properly designed ditches, culverts, riprap, a good plant cover, and catch basins. Surface stones can hinder landscaping. Once the stones are removed, lawns can be easily established.

129B—Woodbridge fine sandy loam, 3 to 8 percent slopes, very stony. This gently sloping soil is on the tops and sides of smooth, rounded hills that in most places have a northwest orientation. Areas are oval or irregularly shaped and are 4 to 100 acres in size. Stones cover 0.01 to 3 percent of the surface.

A generalized profile of this soil is as follows:



Inclusions make up about 25 percent of the map unit. Among these are Ridgebury soils in hollows and drainageways, Paxton soils on knolls and near the margins of the map unit, and Scituate soils in scattered areas throughout the map unit. Also included are soils that have slopes of less than 3 percent or more than 8 percent and areas where less than 0.01 percent of the surface is covered by stones.

Soil features affecting use—

Drainage class: moderately well drained
Depth to a seasonal high water table: 1.5 to 2.5 feet
Depth to bedrock: more than 60 inches
Permeability: moderate in the upper part of the profile and slow in the lower part
Available water capacity: moderate
Flooding: none
Potential for frost action: high
Shrink-swell potential: low

Most areas of this soil are used as woodland.

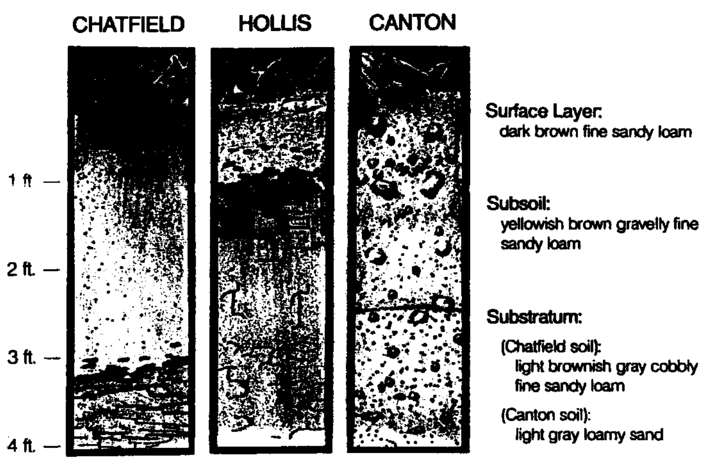
This soil is poorly suited to cultivated crops and forage species because of surface stones. Special machinery, such as stone pickers and bulldozers equipped with rock rakes, is needed to remove the surface stones before cropping can begin. The soil is wet during the early part of the growing season. Working the soil during wet periods results in the formation of ruts, compaction, and clodding.

This soil is well suited to woodland. The most common trees are eastern white pine, red pine, sugar maple, and northern red oak. Areas of this soil are good sites for the production of sawlogs and fuelwood from softwoods or hardwoods. Clear-cutting can result in the invasion of lower quality trees. The quality of trees on the lot can be maintained by some form of partial cutting, in which only a portion of the trees are removed. Shelterwood cutting, in which half of the trees are removed, is not recommended because strong winds may uproot the remaining trees. A better alternative is improvement cutting, in which only a third of the trees are harvested and thus the hazard of windthrow is reduced. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, or midsummer, when the soil is drier, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down.

This soil is suited to urban development, but the wetness and the restricted permeability are limitations. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, though sump pumps may still be needed. Land shaping around the development can help to remove surface water and reduce the hazard of ponding, which can occur after heavy rains. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover. Surface stones can hinder landscaping. Once the stones are removed, lawns can be easily established.

140B—Chatfield-Hollis-Canton complex, 3 to 8 percent slopes, very stony. These gently sloping soils occur as areas so intermingled that mapping them separately was not practical. They are on low, knobby hills and ridges that in most places have a northeast orientation. Areas are irregularly shaped and are 4 to 400 acres in size. They are about 35 percent Chatfield soil, 20 percent Hollis soil, 20 percent Canton soil, and 25 percent other soils. Stones cover 0.01 to 3 percent of the surface.

Generalized profiles of these soils are as follows:



In some areas, the subsoil of the Chatfield and Hollis soils is redder or the bedrock is softer and more rippable. In other areas the substratum of the Canton soil has less silt and more sand and gravel.

Inclusions make up about 25 percent of the map unit. Among these are Newfields soils in the lower landscape positions, Walpole soils along drainageways, Ossipee and Greenwood soils in hollows, and rock outcrops on the tops of ridges and on slope breaks. Also included are areas of Hoosic soils in the seacoast region and areas of Montauk soils.

Soil features affecting use—

Drainage class: Chatfield and Canton—well drained; Hollis—somewhat excessively drained and well drained
Depth to a seasonal high water table: more than 6 feet
Depth to bedrock: Chatfield—20 to 40 inches; Hollis—10 to 20 inches; Canton—more than 60 inches
Permeability: Chatfield and Hollis—moderately rapid; Canton—moderately rapid or rapid
Available water capacity: Chatfield and Canton—moderate; Hollis—very low
Flooding: none
Potential for frost action: Chatfield and Hollis—moderate; Canton—low
Shrink-swell potential: low

Most areas of these soils are used as woodland. Some areas are used for urban development.

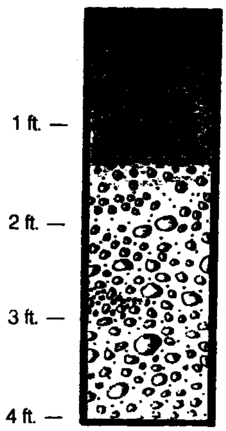
These soils are poorly suited to cultivated crops and forage species because of surface stones and outcrops of bedrock. Special machinery, such as stone pickers and bulldozers equipped with rock rakes, is needed to remove the surface stones before cropping can begin. The outcrops of bedrock can cause damage to farm machinery. Unless they are removed by blasting, they should be avoided during cultivation. Once the soils are cleared of surface stones, erosion, the depth to bedrock, and the available water capacity are continuing management concerns. Erosion control is critical in maintaining the productivity of the Chatfield and Hollis soils because of the depth to bedrock. The available water capacity in the Chatfield and Hollis soils can be improved by adding organic material, such as manure. Crops that are tolerant of droughty conditions should be selected for planting.

These soils are suited to woodland. The most common trees are eastern white pine and northern red oak. The trees are of low quality, and the stands will not be densely stocked. If properly managed, the soils are suitable for the production of fuelwood and can provide habitat for wildlife. In areas managed for fuelwood, scattered ribbon-shaped or kidney-shaped clearcuts should be established throughout the lot. The clearcuts should be no more than 200 feet across. The small clearcuts can reduce the hazard of windthrow and provide a varied habitat for wildlife. Harvesting methods that leave a diversity of trees, such as snag trees, trees with cavities, and a variety of size classes, improve the habitat for wildlife. For a short period in early spring, the soils are wet and intermittent streams are flowing at full capacity. Harvesting during this period causes the formation of ruts and the siltation of streams. Also, machines are likely to become bogged down during this period. A better alternative is logging in winter, when the ground and streams are frozen, or in summer and fall, when the soils are drier and the beds of intermittent streams are dry.

These soils are suited to urban development. Because of the depth to bedrock, careful selection of sites for septic systems and buildings is important. Where bedrock is encountered and areas of deeper soils are not available for use as building sites, blasting may be necessary before basements are constructed and fill may be needed to raise septic systems above

299—Udorthents, smoothed. These soils are in areas that have been excavated and regraded or that have been filled with soil material and graded. Areas are rectangular or irregularly shaped and are 4 to 20 acres in size. Most support vegetation.

A generalized profile of these soils is as follows:



Inclusions make up about 15 percent of the map unit. Among these are natural soils near the margins of the map unit, parking lots and other areas that have an impervious surface, and upgraded areas.

Soil features affecting use—

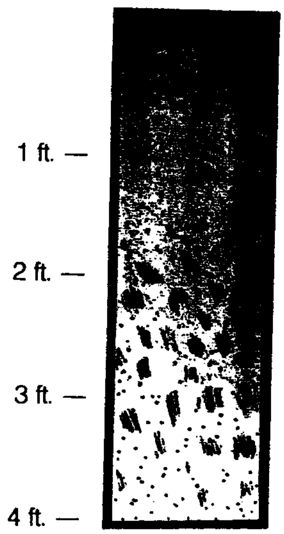
Drainage class: poorly drained to excessively drained
Depth to a seasonal high water table: 0 to more than 6 feet
Depth to bedrock: 10 to more than 60 inches
Permeability: slow to very rapid
Available water capacity: very low to high
Flooding: none
Potential for frost action: low to high
Shrink-swell potential: low or moderate

These soils are used for urban development or landfills or are left idle.

The suitability of these soils for crops, forage, and woodland varies, depending on the degree to which the surface is disturbed. The soil limitations vary so much that the suitability for urban development cannot be specified. Onsite investigation is needed.

313A—Deerfield fine sandy loam, 0 to 3 percent slopes. This nearly level soil is in the slightly higher landscape positions on broad, low plains and on low rises in drainageways. Areas are irregularly shaped and are 4 to 150 acres in size.

A generalized profile of this soil is as follows:



Surface Layer:
dark brown fine sandy loam

Subsoil:
yellowish brown loamy sand

Substratum:
mottled yellowish brown sand

Inclusions make up about 20 percent of the map unit. Among these are Pipestone soils in hollows and drainageways and Windsor soils on the higher rises and knolls. Also included, in the coastal region, are Squamscott soils in drainageways and Eldridge soils in scattered areas.

Soil features affecting use—

Drainage class: moderately well drained
Depth to a seasonal high water table: 1.5 to 3.0 feet
Depth to bedrock: more than 60 inches
Permeability: moderately rapid or rapid
Available water capacity: low
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland. Some areas are used for urban development.

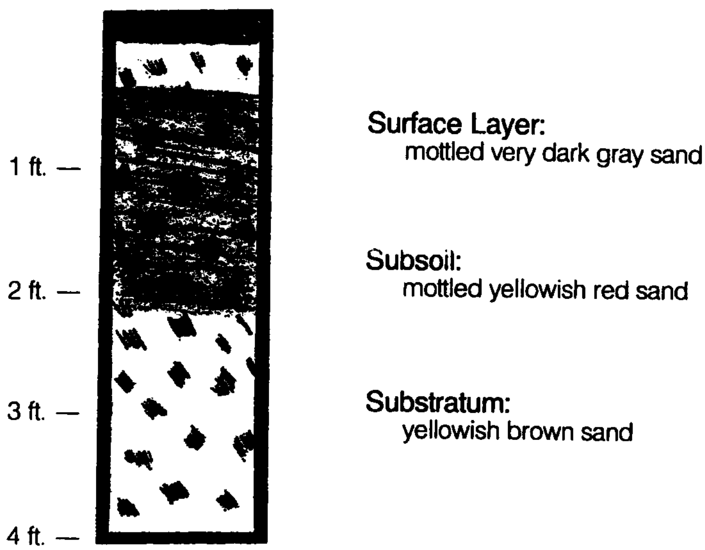
This soil is suited to cultivated crops and forage species, but it is wet in early spring. The wetness hampers early planting of the crops that require a long growing season. Working the soil during wet periods results in the formation of ruts and compaction. If the wetness in areas of cropland is reduced by a subsurface drainage system, the crops can be planted on schedule. In pastured areas, where a subsurface drainage system is not economically feasible, open drainage ditches can reduce the wetness. Farm machinery should not be used when the soil is wet. Because of the sandy texture, the soil may be droughty in summer. Certain crops, such as vegetables, may require irrigation in summer to maintain yields.

This soil is well suited to woodland. The most common trees are eastern white pine, red maple, and northern red oak. Areas of this soil are good sites for white pine and produce high-quality pine sawlogs, but care must be taken to keep hardwoods from invading. For example, after an area has been clearcut, gray birch, white oak, and other hardwoods will reseed rather than white pine. Management that favors the regeneration of white pine includes cuttings in which only a portion of the trees are harvested. Scarifying the surface after the trees are harvested can help the pine seeds to sprout. Stands of white pine respond well to intensive stand improvement measures, such as pruning. Because of the sandy texture, water moves downward through the soil quickly and the trees can be harvested any time of the year, except for a short period in early spring. Wet, narrow drainageways extend through areas of this soil. If possible, skid trails should be routed around these drainageways.

This soil is suited to urban development, but the wetness in early spring, a poor filtering capacity, and frost action are limitations. Footing drains can help to keep cellars dry if drainage outlets are available. If outlets are not available, sump pumps may be needed. Fill is generally used to raise septic tank absorption fields above the seasonal high water table. Because of the sandy texture, the soil is poor filtering material for the leachate from septic systems. The effluent may pass through the soil too fast to be adequately purified before reaching the water table. Care is needed in excavating the soil because steep cutbanks commonly cave in. Adding retaining walls or grading long side slopes can keep the banks from collapsing. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving.

314A—Pipestone sand, 0 to 5 percent slopes. This nearly level and gently sloping soil is in broad basins and drainageways of wide plains and in narrow drainageways between hills. Areas are irregularly shaped and are 4 to 150 acres in size. In most places, the surface has scattered low hummocks less than 1 foot in height.

A generalized profile of this soil is as follows:



Inclusions make up about 25 percent of the map unit. Among these are Deerfield soils on low rises, Scarboro and Chocorua soils in basins and drainageways, and soils that have a cemented layer at a depth of about 1 foot. Also included, in the seacoast region, are Squamscott soils and soils that have a loamy substratum at a depth of more than 40 inches.

Soil features affecting use—

Drainage class: somewhat poorly drained
Depth to a seasonal high water table: 0.5 foot to 1.5 feet
Depth to bedrock: more than 60 inches
Permeability: rapid
Available water capacity: low
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland. In places the soil is classified as wetland.

This soil is poorly suited to cultivated crops and forage species. It is wet in spring. The wetness hampers early planting of the crops that require a long growing season. Working the soil during wet periods results in the formation of ruts and compaction. If the wetness in areas of cropland is reduced by a subsurface drainage system, the crops can be planted on schedule. Land grading also can reduce the wetness. Grazing of undrained pasture should be delayed until the soil dries out. Farm machinery should not be used when the soil is wet. Because of the sandy texture, the soil may be droughty in summer. Certain crops, such as vegetables, may require irrigation in summer to maintain yields.

This soil is suited to woodland. The most common trees are red maple, eastern white pine, and northern red oak. Areas of this soil can be good sites for white pine and produce high-quality pine sawlogs, but hardwoods may dominate the site or may be introduced through management practices. For example, after an area has been clearcut, red maple, elm, and other hardwoods will reseed rather than white pine. An alternative that would favor the regeneration of white pine is improvement cutting, in which approximately a third of the trees are harvested. Shelterwood cutting, in which half of the trees are removed, is not recommended because of the hazard of windthrow. Scarifying the surface after the trees are harvested can help the pine seeds to sprout. If hardwoods dominate the site, the area can be managed for fuelwood. Small, ribbon-shaped or kidney-shaped clearcuts in scattered areas throughout the lot can reduce the hazard of windthrow and provide a varied habitat for wildlife. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, or midsummer, when the soil is drier, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down.

This soil is poorly suited to urban development. The wetness, a poor filtering capacity, and frost action are limitations. Footing drains can help to keep cellars dry if drainage outlets are available. If outlets are not available, sump pumps may be needed. Fill is generally used to raise septic systems above the seasonal high water table. Because of the sandy texture, the soil is poor filtering material for the leachate from septic systems. The effluent may pass through the soil too fast to be adequately purified before reaching the water table. Care is needed in excavating the soil because steep cutbanks commonly cave in. Adding retaining walls or grading long side slopes can keep the banks from collapsing. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings.

397—Ipswich mucky peat. This nearly level soil is in tidal marshes. Areas are irregularly shaped and are 4 to 1,000 acres in size. The content of salts in the soil is more than 1 percent.

A generalized profile of this soil is as follows:

Inclusions make up about 10 percent of the map unit. Among these are Pawcatuck soils near the central part of the marshes and Westbrook soils near the margins of the marshes.

Soil features affecting use—

Drainage class: very poorly drained
Seasonal high water table: at the surface or as much as 1 foot above the surface
Depth to bedrock: more than 60 inches
Permeability: moderate
Available water capacity: high
Flooding: frequent
Potential for frost action: high

Most areas of this soil are used as wildlife habitat. In most places the soil is classified as wetland.

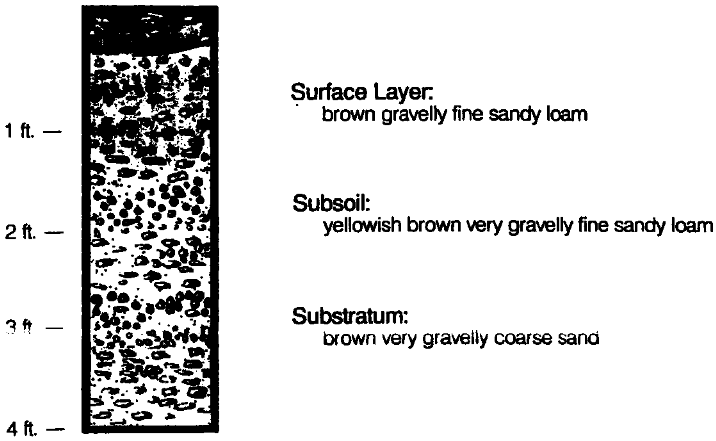
This soil is generally unsuited to woodland. Because of the frequent flooding and high salinity, trees cannot grow in the tidal marshes.

This soil is unsuited to cultivated crops and forage species. Because of the periodic flooding by tidal seawater, the wetness, low strength, and the content of salts, farming is impractical. The only suitable plants are those that can withstand a high content of salts.

This soil is very poorly suited to urban development because of the tidal flooding.

510B—Hoosic gravelly fine sandy loam, 3 to 8 percent slopes. This gently sloping soil is on low hills, knolls, and ridges, generally at an elevation of 60 to 160 feet. Areas are oval or irregularly shaped and are 5 to 100 acres in size.

A generalized profile of this soil is as follows:



Inclusions make up about 10 percent of the map unit. Among these are moderately well drained soils in hollows and soils that are underlain by hard bedrock or have a dense hardpan in the substratum.

Soil features affecting use—

Drainage class: somewhat excessively drained
Depth to a seasonal high water table: more than 6 feet
Depth to bedrock: more than 60 inches
Permeability: moderately rapid in the upper part of the profile and very rapid in the lower part
Available water capacity: low
Flooding: none
Potential for frost action: low
Shrink-swell potential: low

Most areas of this soil are used for cultivated crops or forage. Some areas are used for urban development, and some are used as woodland. In most areas the soil is classified as additional farmland of statewide importance. It is a source of sand and gravel.

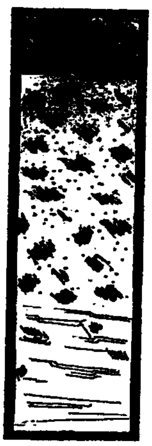
This soil is suited to cultivated crops and forage species, but it is droughty during dry summers. Adding organic material, such as manure or crop residue, can increase the available water capacity. Certain crops, such as vegetables, may require irrigation during the dry summers to maintain yields. Because of the summer droughtiness, the soil is most productive as pasture in early spring. Because of the slope, erosion is a hazard. In areas used for corn silage, this hazard can be reduced by no-till farming and other forms of conservation tillage or by short rotations, such as 2 years of corn and 5 years of hay. In areas where row crops, such as vegetables, are grown year after year, diversions and terraces may be needed as erosion-control measures.

This soil is well suited to woodland. The most common trees are eastern white pine, sugar maple, and northern red oak. Areas of this soil are good sites for white pine and produce high-quality pine sawlogs, but care must be taken to keep hardwoods from invading. For example, after an area has been clearcut, gray birch, white oak, and other hardwoods will reseed rather than white pine. Management that favors the regeneration of white pine includes cuttings in which only a portion of the trees are harvested. Scarifying the surface after the trees are harvested can help the pine seeds to sprout. Stands of white pine respond well to intensive stand improvement measures, such as pruning. Because the soil is droughty, the trees can be harvested any time of the year, even in spring.

This soil is well suited to urban development. Because of the sandy texture, however, it is poor filtering material for the leachate from septic systems. The effluent may pass through the soil too fast to be adequately purified before reaching the water table. Care is needed in excavating the soil because steep cutbanks commonly cave in. Adding retaining walls or grading long side slopes can keep the banks from collapsing. Lawns may require irrigation during dry summers, when the soil is droughty. Incorporating organic material, such as plant residue or manure, into the soil can increase the available water capacity. Mulching and frequent watering may be required in disturbed areas. Erosion is a hazard during earth-moving operations. Common erosion- and sediment-control measures are sediment traps and a good plant cover.

538A—Squamscott fine sandy loam, 0 to 5 percent slopes. This nearly level and gently sloping soil is in drainageways and on broad, low plains. Areas are irregularly shaped and are 4 to 150 acres in size. Scattered hummocks that are about 1 foot high are throughout the map unit.

A generalized profile of this soil is as follows:



1 ft. —
2 ft. —
3 ft. —
4 ft. —

Surface Layer:
mottled light brownish gray fine sandy loam

Subsoil:
mottled brownish yellow loamy sand

Substratum:
mottled gray silt loam

In places depth to the loamy substratum is more than [illegible] inches.

Inclusions make up about 15 percent of the map unit. Among these are Scitico and Maybid soils in hollows and drainageways and Eldridge soils on low rises and knolls.

Soil features affecting use—

Drainage class: poorly drained
Depth to a seasonal high water table: 0 to 1 foot
Depth to bedrock: more than 60 inches
Permeability: rapid in the upper part of the profile and moderately slow in the lower part
Available water capacity: high
Flooding: none
Potential for frost action: high
Shrink-swell potential: low

Most areas of this soil are used as woodland. Some areas are used for cultivated crops or forage. In places the soil is classified as wetland.

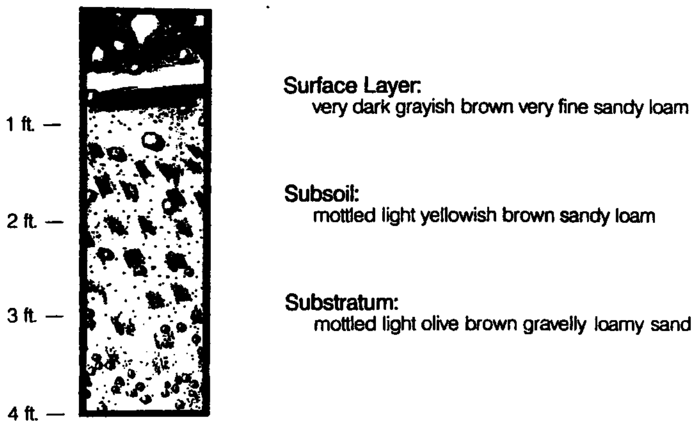
This soil is suited to cultivated crops and forage species, but it is wet in spring. The wetness hampers early planting of the crops that require a long growing season. Working the soil during wet periods results in the formation of ruts and compaction. Although a subsurface drainage system may not be effective, land grading can reduce the wetness. Early planting should be avoided. Grazing of undrained pasture should be delayed until the soil dries out. Farm machinery should not be used when the soil is wet.

This soil is suited to woodland. The most common trees are red maple and eastern white pine. Areas of this soil can be good sites for white pine and produce high-quality pine sawlogs, but hardwoods may dominate the site or may be introduced through management practices. For example, after an area has been clearcut, red maple, aspen, or elm will reseed rather than white pine. An alternative that would favor the regeneration of white pine is improvement cutting, in which approximately a third of the trees are harvested. Shelterwood cutting, in which half of the trees are removed, is not recommended because of the hazard of windthrow. Scarifying the surface after the trees are harvested can help the pine seeds to sprout. If hardwoods dominate the site, the area can be managed for fuelwood. Small, ribbon-shaped or kidney-shaped clearcuts in scattered areas throughout the lot can reduce the hazard of windthrow and provide a varied habitat for wildlife. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, or midsummer, when the soil is drier, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down.

This soil is poorly suited to urban development because of the wetness, ponding, frost action, and the restricted permeability. Fill is generally used to raise septic systems above compact soil layers and the seasonal high water table. Footing drains around the foundations can reduce the wetness, but outlets for the drains may not be available. Sump pumps may still be needed. Storm water management is critical because of the restricted permeability. Land shaping, ditching, and installing culverts around the development can help to remove surface water, but ponding may still occur after heavy rains. Because of the potential for frost action, foundations should have adequate footings. Properly designing road subgrades can reduce the hazard of frost heaving.

546A—Walpole very fine sandy loam, 0 to 5 percent slopes. This nearly level and gently sloping soil is in drainageways. Areas are long and narrow or irregularly shaped and are 4 to 30 acres in size.

A generalized profile of this soil is as follows:



Inclusions make up about 15 percent of the map unit. Among these are Scarboro soils in scattered areas throughout the map unit and Newfields soils on low rises and near the margins of the map unit.

Soil features affecting use—

Drainage class: poorly drained
Depth to a seasonal high water table: 0 to 1 foot
Depth to bedrock: more than 60 inches
Permeability: moderately rapid or rapid
Available water capacity: moderate
Flooding: none
Potential for frost action: moderate
Shrink-swell potential: low

Most areas of this soil are used as woodland. Some areas are used for cultivated crops or forage. In places the soil is classified as wetland.

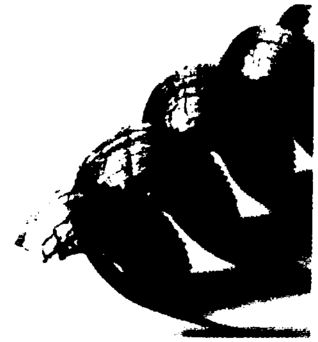
This soil is suited to cultivated crops and forage species, but it is wet in spring. The wetness hampers early planting of the crops that require a long growing season. Working the soil during wet periods results in the formation of ruts, compaction, and the siltation of nearby streams. If the wetness in areas of cropland is reduced by a subsurface drainage system, the crops can be planted on schedule. Land grading also can reduce the wetness. Grazing of undrained pasture should be delayed until the soil dries out. Farm machinery should not be used when the soil is wet. Frost action is a limitation. Perennial plants that can withstand wetness and frost action should be selected for planting. For example, alfalfa does not grow well on this soil because frost heaving damages the roots. A better choice of perennial forage would be a grass-legume mixture that includes clover.

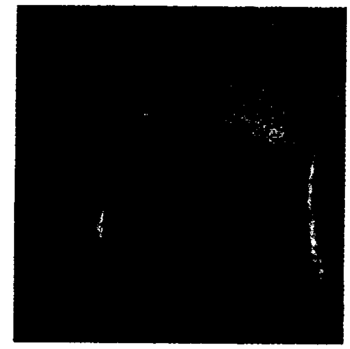
This soil is suited to woodland. The most common trees are red maple, eastern white pine, white ash, and eastern hemlock. The trees are of low quality, though the stands may be densely stocked and yields may be high. The site conditions favor the production of fuelwood. Various species of wildlife are attracted to areas of this soil. In areas managed for fuelwood, scattered ribbon-shaped or kidney-shaped clearcuts should be established throughout the lot. The clearcuts should be no more than 200 feet across. The small clearcuts can reduce the hazard of windthrow and provide a varied habitat for wildlife. Harvesting methods that leave a diversity of trees, such as snag trees, trees with cavities, and a variety of size classes, improve the habitat for wildlife. The soil is wet in spring and late fall. Logging in midwinter, when the ground is frozen, or midsummer, when the soil is drier, helps to prevent the formation of ruts and reduces the likelihood that the equipment will become bogged down.

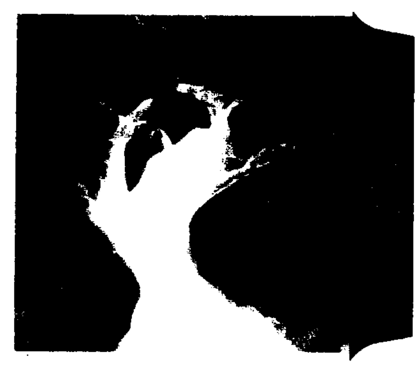
This soil is poorly suited to urban development. The wetness, a poor filtering capacity, and frost action are limitations. Land shaping and grading can reduce the wetness. Footing drains can help to keep cellars dry if drainage outlets are available. If outlets are not available, sump pumps may be needed. Fill is generally used to raise septic systems above the seasonal high water table. Because of the sandy texture, the soil is poor filtering material for the leachate from septic systems. The effluent may pass through the soil too rapidly to be adequately purified before reaching the water table. Care is needed in excavating the soil because steep cutbanks commonly cave in. Adding retaining walls or grading long side slopes can keep the banks from collapsing. Frost action is a limitation. A properly designed road subgrade is needed to prevent frost heaving. Because of the potential for frost action, foundations should have adequate footings.

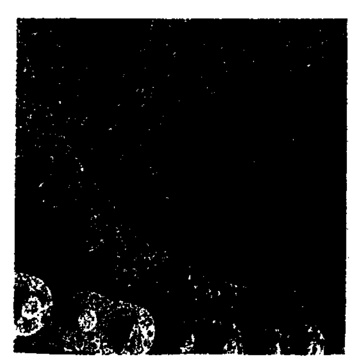
GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering







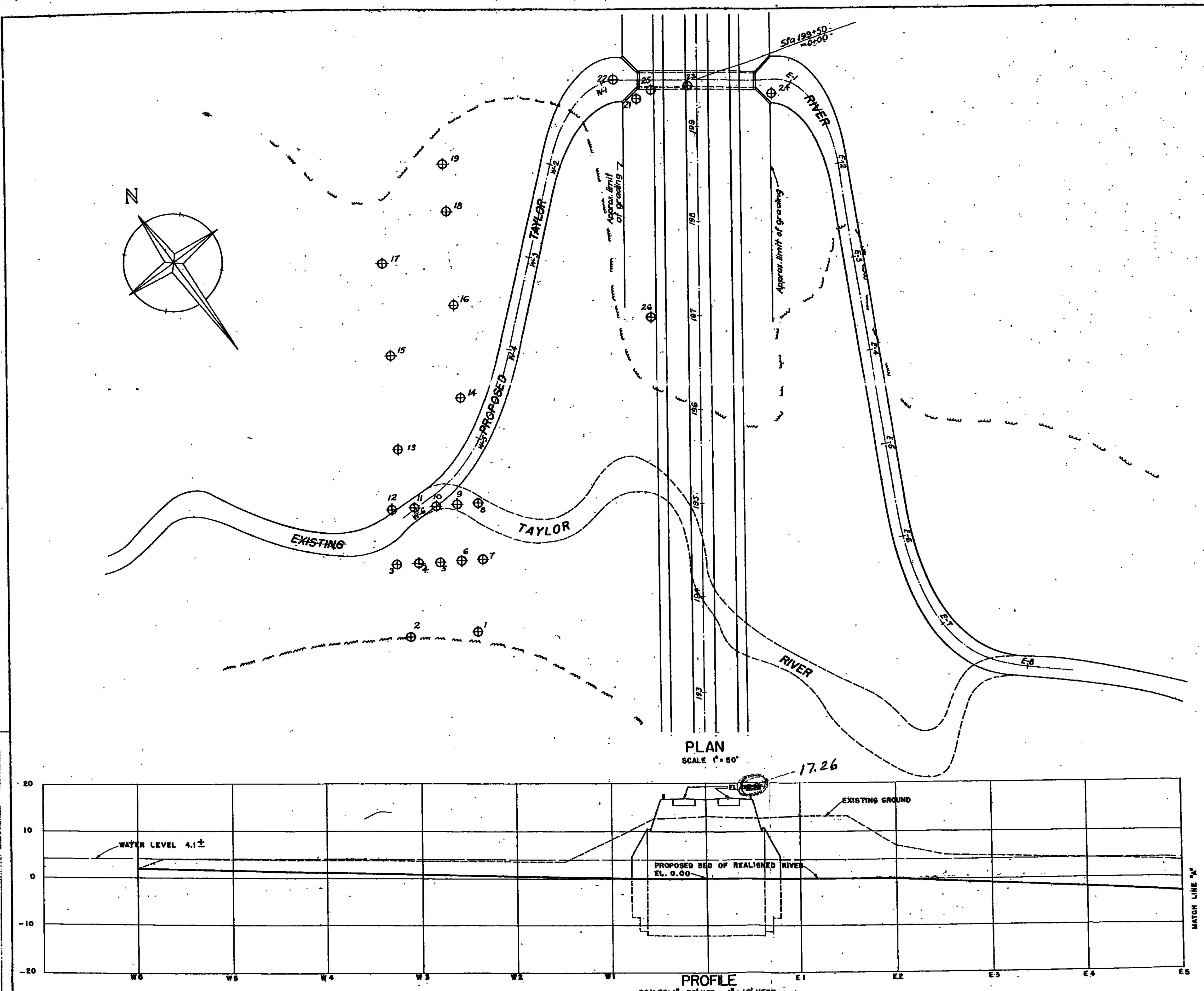


Appendix C

Subsurface Information from 1948 and 1971-1972 NHDOT Drawings

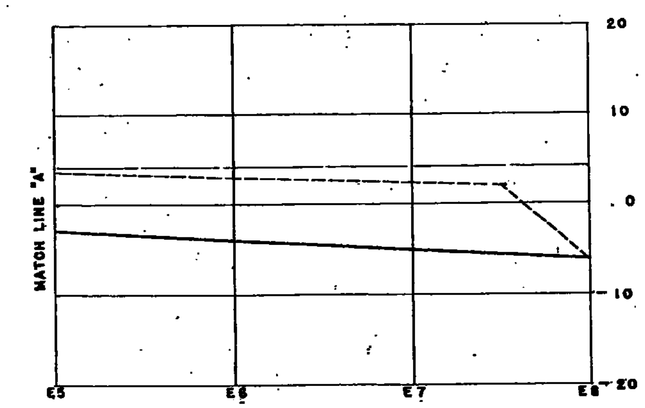
FED. ROAD DIST. NO.	STATE	PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
8	N. H.				-

WORKING DRAWING NO. 26



NOTES

AT THE OPTION OF THE CONTRACTOR AND SUBJECT TO THE APPROVAL OF THE ENGINEER THE CHANNEL MAY BE EXCAVATED BY THE USE OF EXPLOSIVES. PAYMENT WILL BE MADE UNDER ITEM 7.3— UNCLASSIFIED CHANNEL EXCAVATION.



NEW HAMPSHIRE HIGHWAY DEPARTMENT
NEW HAMPSHIRE TURNPIKE

TAYLOR RIVER
STRUCTURE NO. 5
PLAN & PROFILE

SCALE AS SHOWN — DATE AUG. 15, 1948

PARSONS, BRINCKERHOFF, HOGAN AND MACDONALD
ENGINEERS — NEW YORK

PROJ. NO.	SHEET NO.
LS 18(5)	26

REVISIONS AFTER PROPOSAL — DATE — STA. TO STA. — DESCRIPTION

PLAN TRACED BY — CHECKED — PROFILE TRACED BY — CHECKED — DATE

NOTE BOOK — BOOK NO. — PAGE

LEGEND

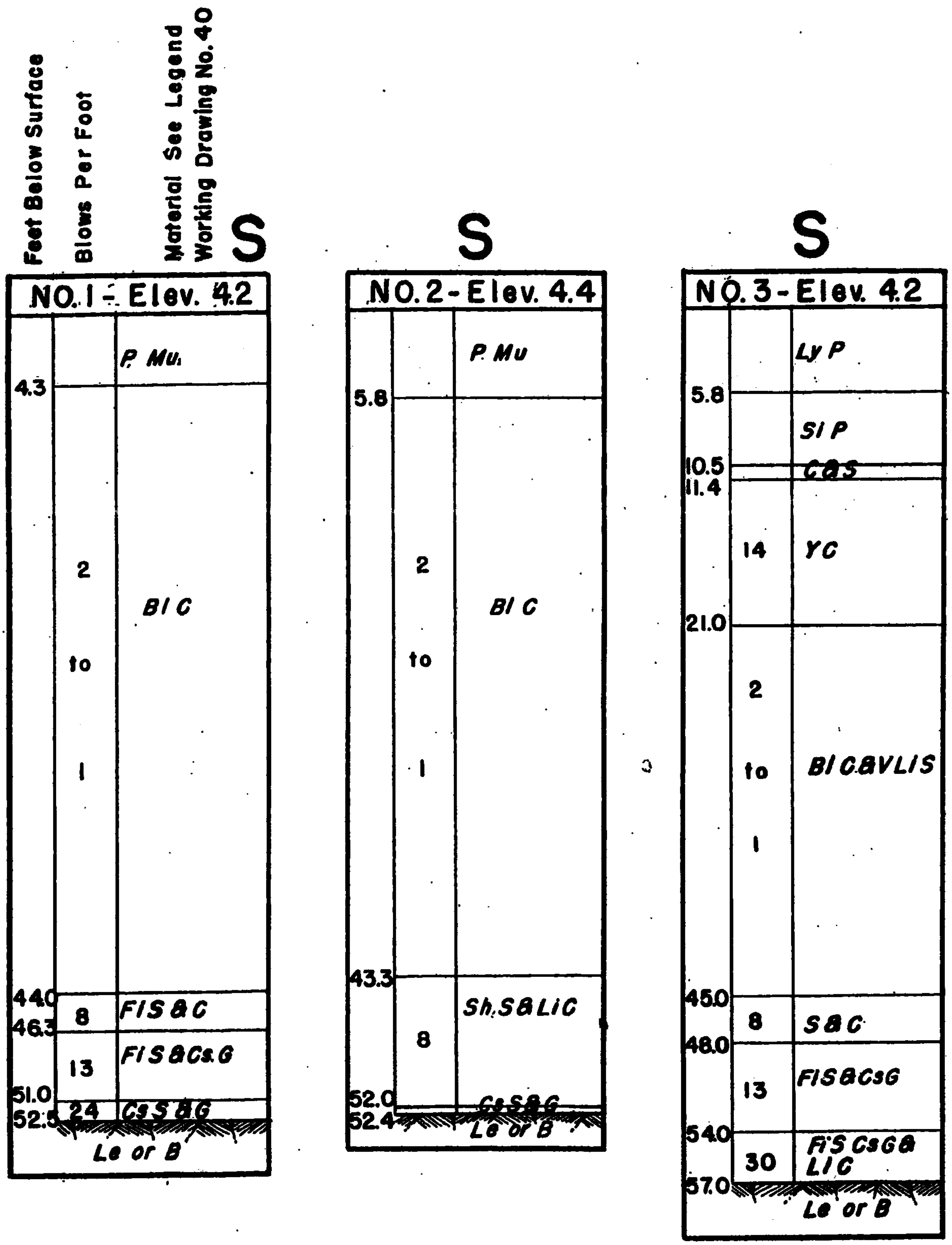
B - Boulder
BH - Bottom of Hole
Bl - Blue
BR - Bed Rock
Br - Brown
C - Clay
Co - Compact
Cs - Coarse
F - Fill
Fi - Fine
Fm - Firm
G - Gravel
Gr - Grey
H - Hard
Hn - Hardpan
L - Loam
Le - Ledge
Li - Little
Ls - Loose
Ly - Loamy
M - Medium
Mu - Mud
P - Peat
R - Rock
Rd - Road
S - Sand
Sa - Sandy
Sd - Solid
Se - Seamy
Sh - Sharp
Si - Silt
Sm - Small
So - Soft
St - Stones
Sy - Shaley
V - Very
W - Water
Y - Yellow

BLOWS PER FT. ARE BLOWS REQUIRED TO DRIVE 1⅞" PIPE ONE FT., USEING 135 lb. WEIGHT FALLING TWO FT., EXCEPT AS NOTED BELOW.

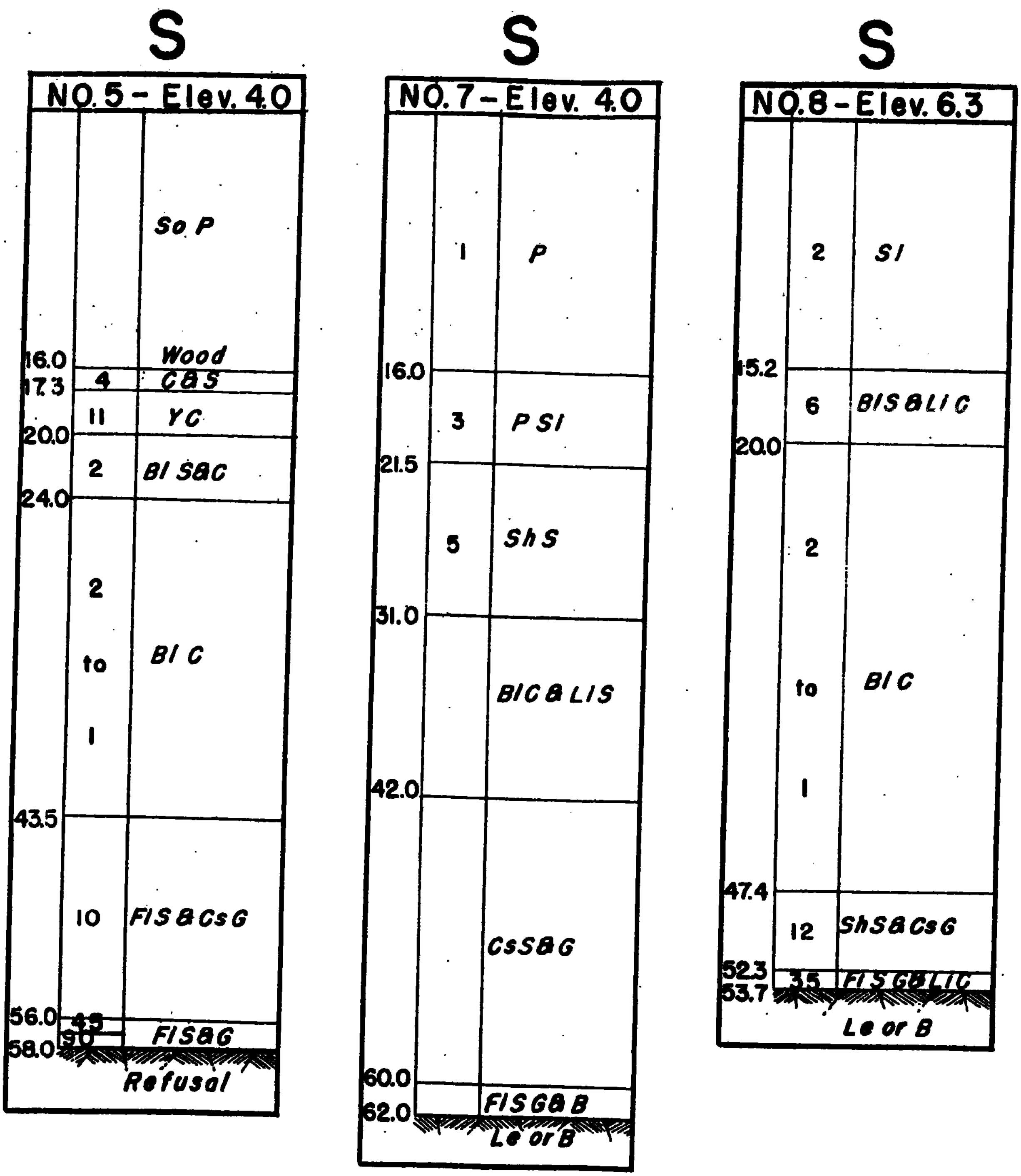
THE INTERPRETATION OF BORINGS IS NOT GUARANTEED TO SHOW ACTUAL CONDITIONS. CONTRACTORS MAY INSPECT SAMPLES OF BORINGS AT THE OFFICE OF THE DEPARTMENT AND MAKE THEIR OWN INTERPRETATION.

S ALL BORINGS MARKED "S" ARE 125 LB. HAMMER, BLOWS ON SPOON.

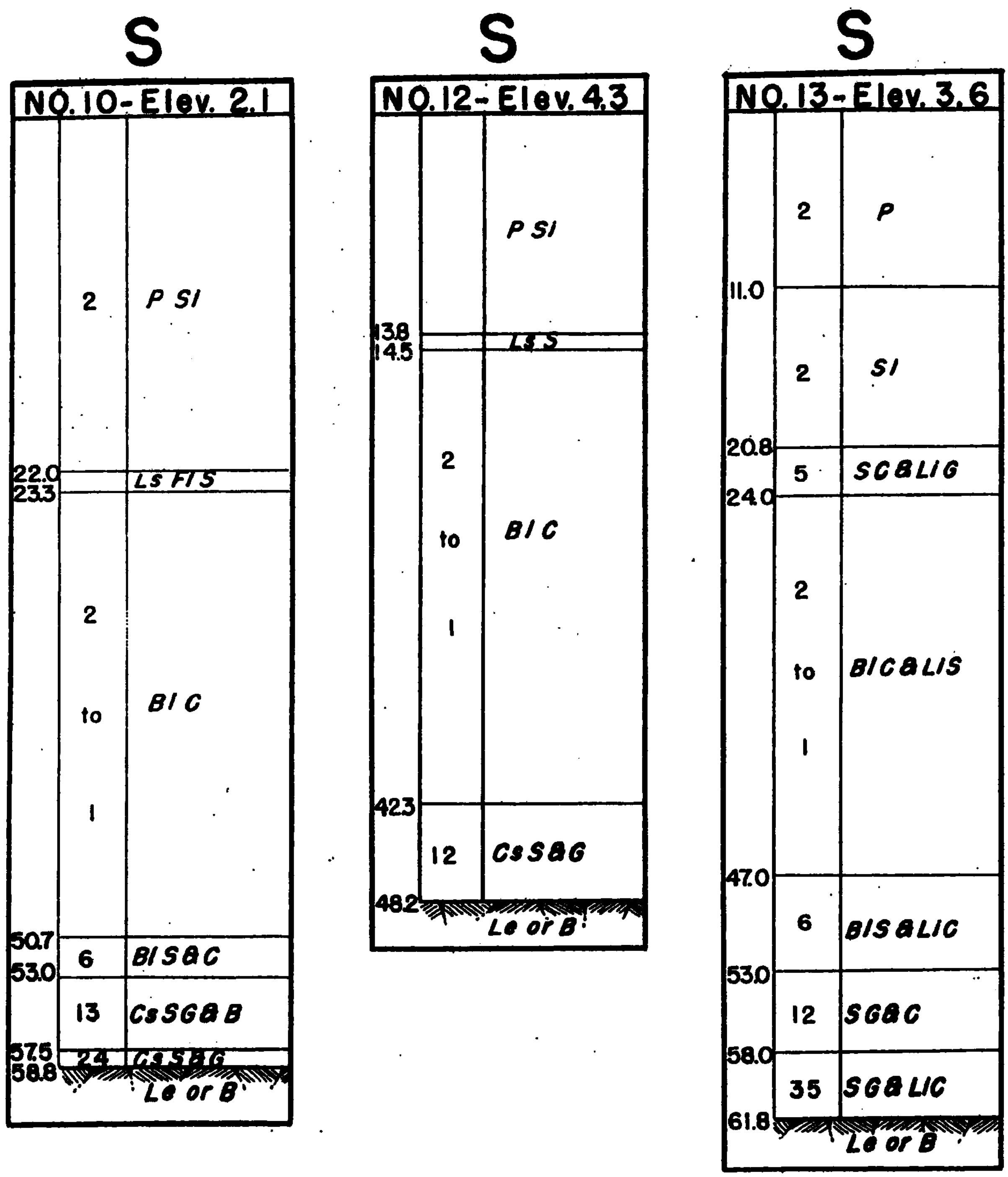
NEW HAMPSHIRE HIGHWAY DEPARTMENT NEW HAMPSHIRE TURNPIKE
ROUTE 101-D STR. NO. 9 HAMPTON FALLS - EXETER RD. STR. NO. 4 OCEAN RD. STR. NO. 13 POST RD. STR. NO. 11 HAMPTON - EXETER RD. STR. NO. 8 BORINGS
SCALE: NONE DATE AUG. 15, 1948
PARSONS, BRINCKERHOFF, HOGAN & MACDONALD ENGINEERS NEW YORK



Note: Borings Nos. 4, 6, 9, 11, 20 No Data



S
NO. 5 - Elev. 4.0
So P
16.0
Wood
17.3
4
C & S
11
YC
20.0
2
Bl S & C
24.0
2
to
1
Bl C
43.5
10
Fl S & Cs G
56.0
45
90
Fl S & G
58.0
Refusal
S
NO. 7 - Elev. 4.0
1
P
16.0
3
P Sl
21.5
5
Sh S
31.0
Bl C & Ll S
42.0
Cs S & G
60.0
Fl S G & B
62.0
Le or B
S
NO. 8 - Elev. 6.3
2
Sl
15.2
6
Bl S & Ll C
20.0
2
to
1
Bl C
47.4
12
Sh S & Cs G
52.3
35
Fl S G & Ll C
53.7
Le or B


S
NO. 10 - Elev. 2.1
2
P Sl
22.0
Ls Fl S
23.3
2
to
1
Bl C
50.7
6
Bl S & C
53.0
13
Cs S G & B
57.5
24
Cs S & G
58.8
Le or B
S
NO. 12 - Elev. 4.3
P Sl
13.8
Ls S
14.5
2
to
1
Bl C
42.3
12
Cs S & G
48.2
Le or B
S
NO. 13 - Elev. 3.6
2
P
11.0
2
Sl
20.8
5
S C & Lt G
24.0
2
to
1
Bl C & Lt S
47.0
6
Bl S & Lt C
53.0
12
S G & C
58.0
35
S G & Lt C
61.8
Le or B

S

NO. 14 - Elev. 4.1

Depth		
10.0	1	So P
15.0	2	Sl
27.0	7	Sl S & Shell
28.5	8	S & G
52.3	1	Bl C
58.5	9	CFlS & LlG
63.0	24	C S & G
		Le or B

S

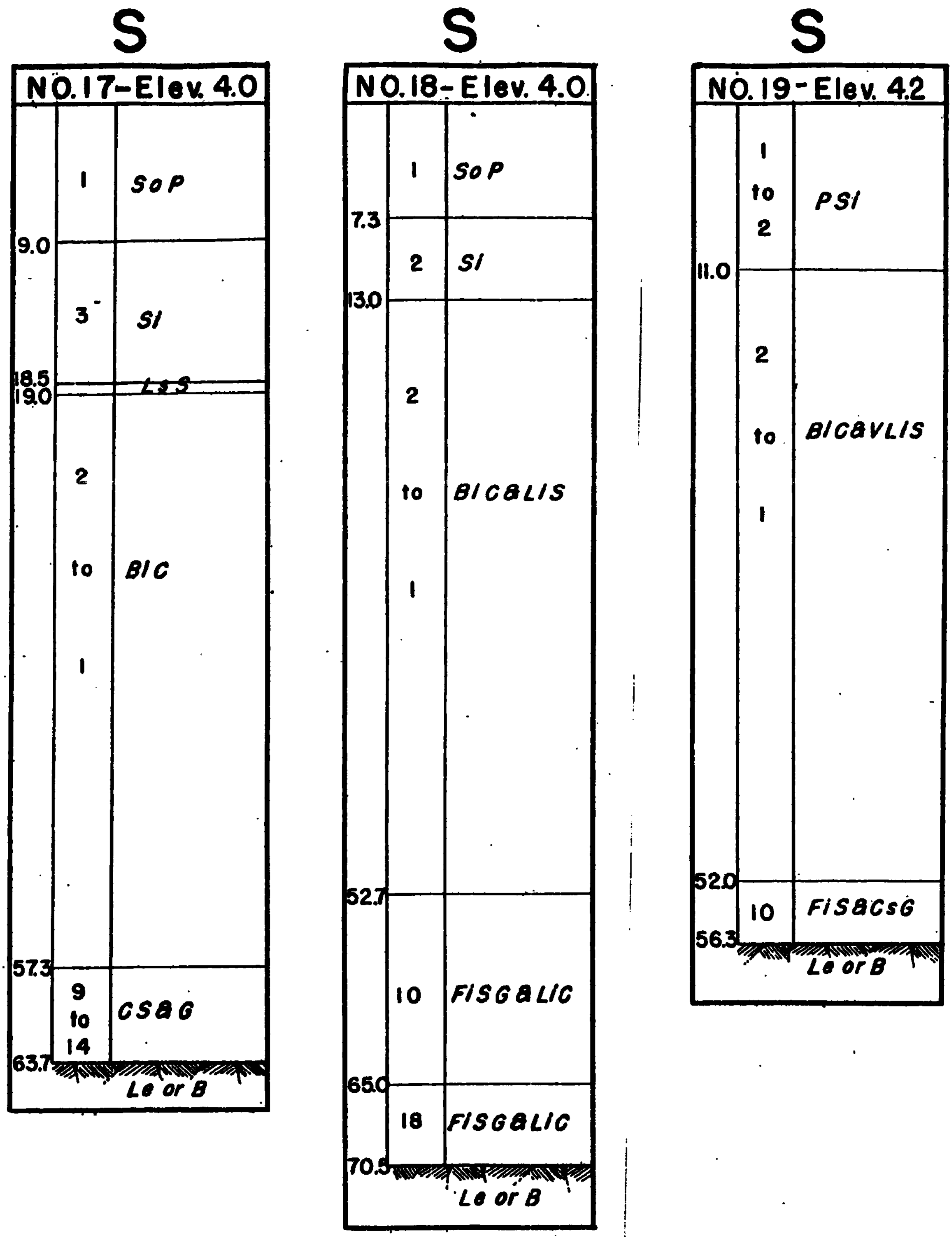
NO. 15 - Elev. 4.2

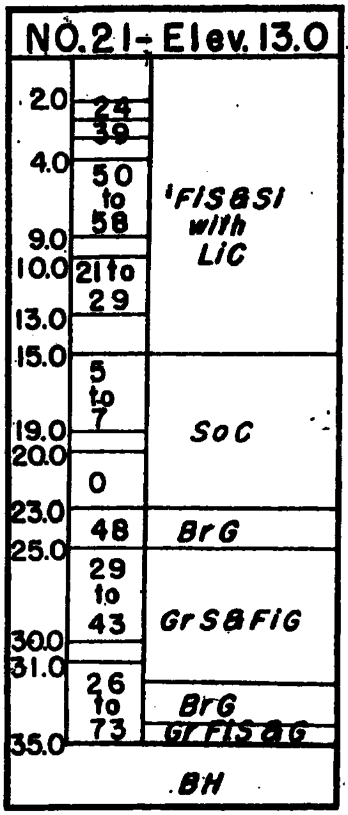
Depth		
10.5	1	P Sl
18.3	2	Sl
30.0	5	Sh Sl S
58.3	2 to 1	Bl C & LlS
67.0	9 to 12	FlS & LlG
69.4	26	FlSG & LlC
		Le or B

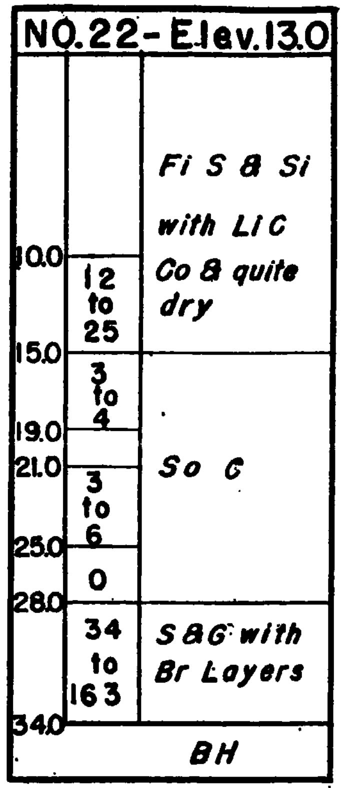
S

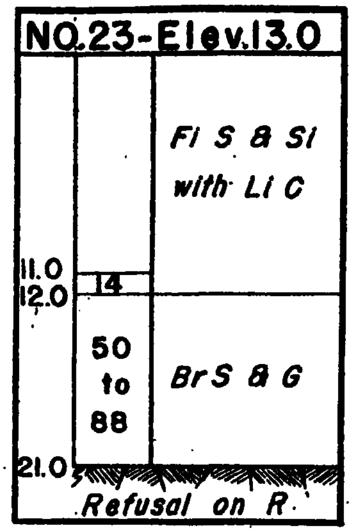
NO. 16 - Elev. 4.1

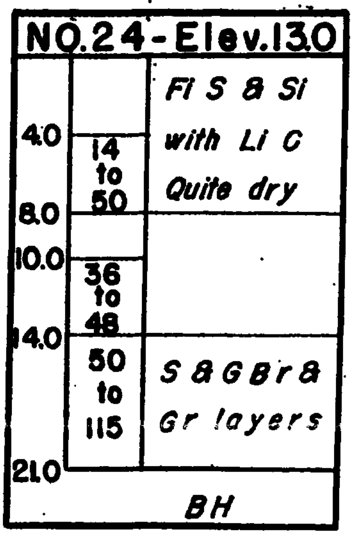
Depth		
9.3	1	So P
18.7	2	Sl
52.5	2 to 1	Bl C & VLlS
60.3	10 to 14	FlSG & VLlC
		Le or B

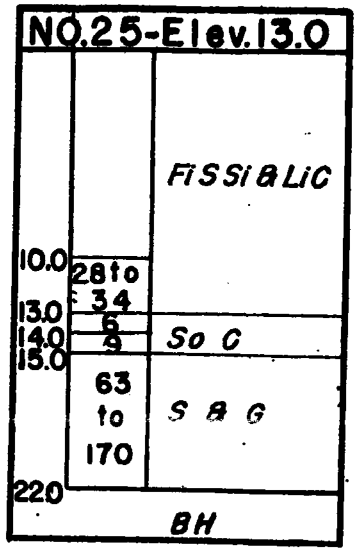

S
NO.17-Elev. 4.0
1
SoP
9.0
3
Sl
18.5
LsS
19.0
2
to
1
BlC
57.3
9
to
14
CS&G
63.7
Le or B
S
NO.18-Elev. 4.0
1
SoP
7.3
2
Sl
13.0
2
to
1
BlC&LIS
52.7
10
FlSG&LIC
65.0
18
FlSG&LIC
70.5
Le or B
S
NO.19-Elev. 4.2
1
to
2
PSl
11.0
2
to
1
BlC&VLIS
52.0
10
FlS&CsG
56.3
Le or B

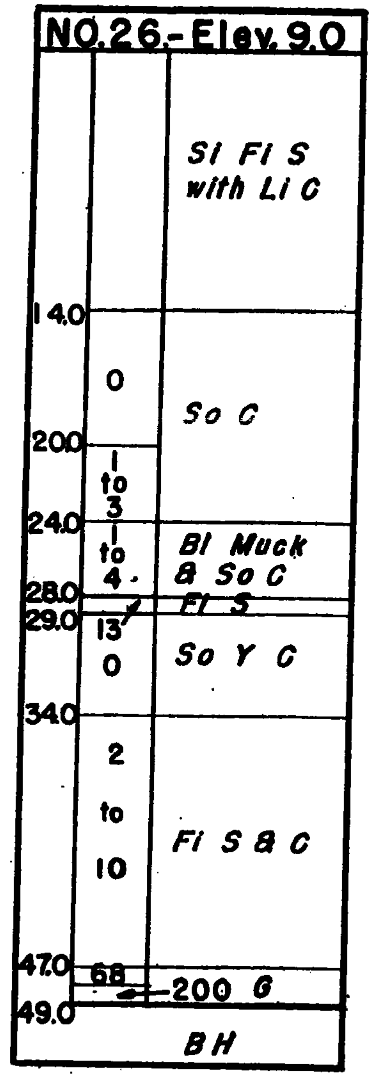

NO.21- Elev.13.0
2.0
24
39
4.0
50 to 58
FI S & SI with LiC
9.0
10.0
21 to 29
13.0
15.0
5 to 7
19.0
20.0
SoC
0
23.0
48
BrG
25.0
29 to 43
GrS&FiG
30.0
31.0
26 to 73
BrG
Gr FI S & G
35.0
BH


NO.22- Elev.13.0
Fi S & Si with LiC Co & quite dry
10.0
12 to 25
15.0
3 to 4
19.0
21.0
3 to 6
So C
25.0
0
28.0
34 to 163
S&G with Br Layers
34.0
BH

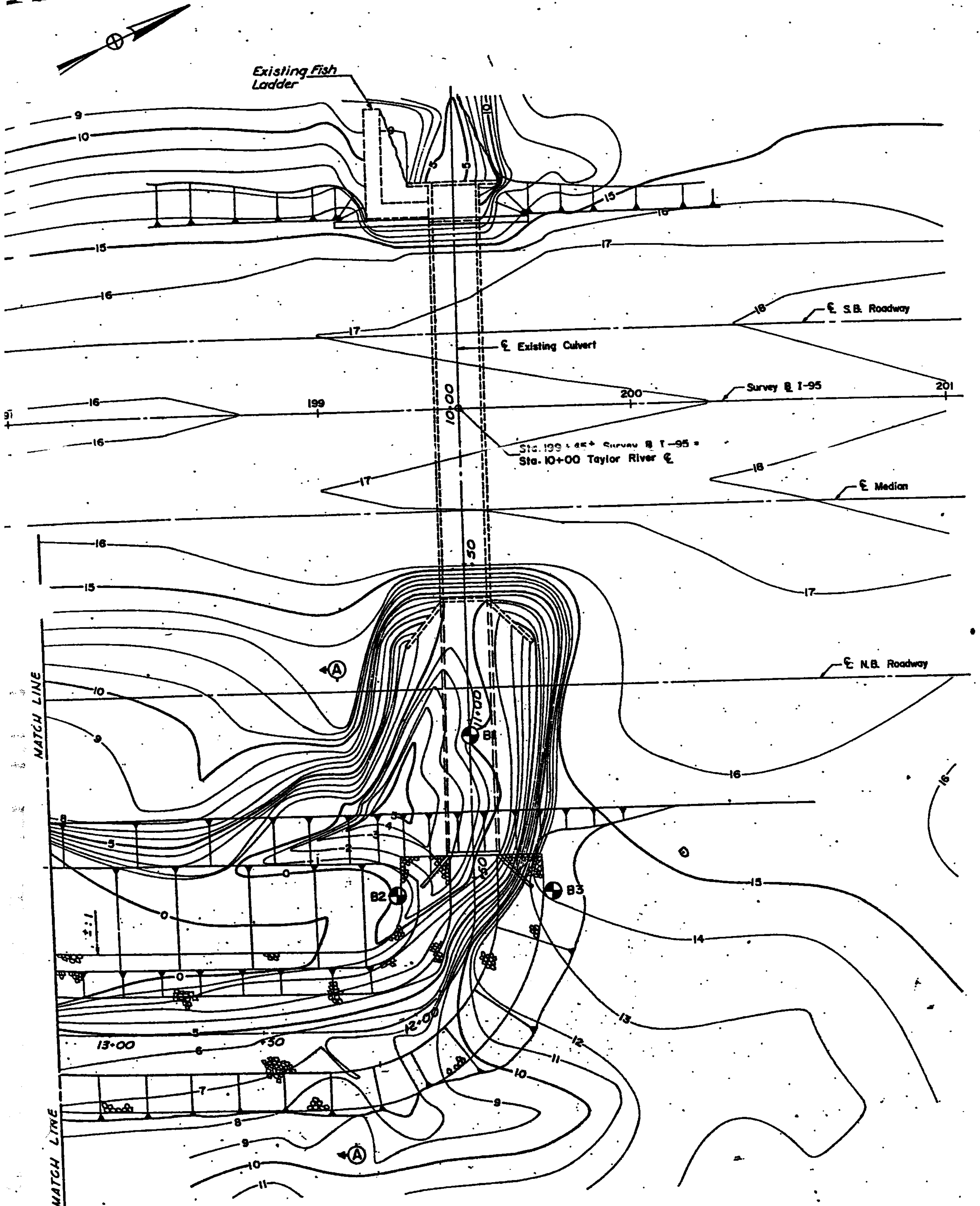

NO.23- Elev.13.0
Fi S & Si with Li C
11.0
14
12.0
50 to 88
BrS & G
21.0
Refusal on R


NO.24-Elev.13.0
4.0
8.0
10.0
14.0
21.0
14 to 50
36 to 48
50 to 115
Fl S & Si with Li C Quite dry
S & G Br & Gr layers
BH


NO.25-Elev.13.0
10.0
13.0
14.0
15.0
22.0
28 to 34
6
9
63 to 170
Fl S Si & Li C
So C
S & G
BH

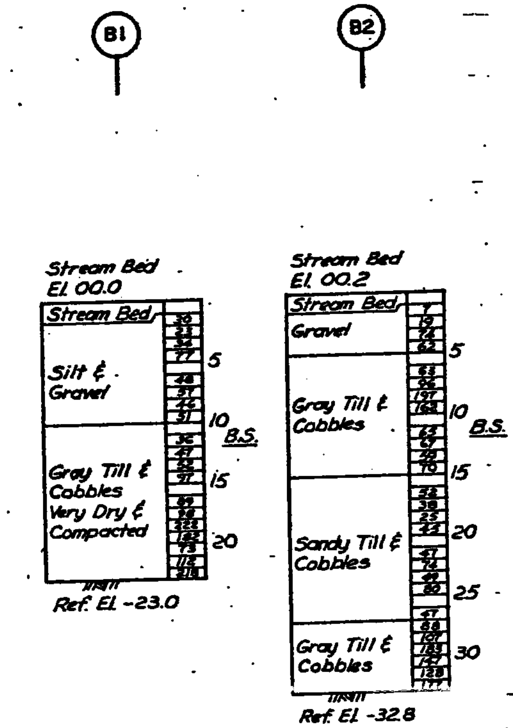

NO.26-Elev.9.0
14.0
20.0
24.0
28.0
29.0
34.0
47.0
49.0
0
1 to 3
1 to 4
13
0
2 to 10
68
Si Fl S with Li C
So C
Bl Muck & So C
Fl S
So Y C
Fl S & C
200 G
BH

FED. ROAD DIV. NO.	STATE	PROJ.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
1	N. H.				



BORING LAYOUT & CONTOUR PLAN

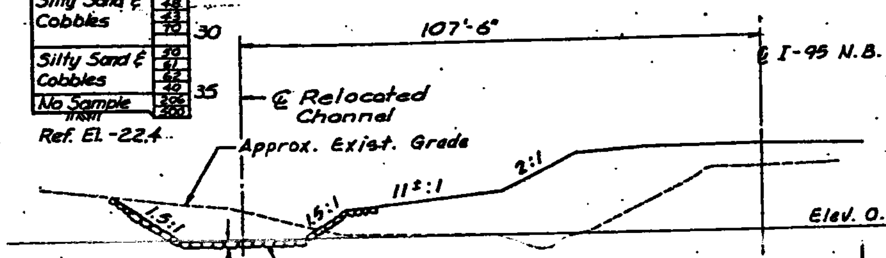
1" = 20'



B.S.[⊕] = Bottom of Steel Sheet Piling

LOG OF BORINGS

Vertical 1/8" = 1'-0"



SECTION A–A

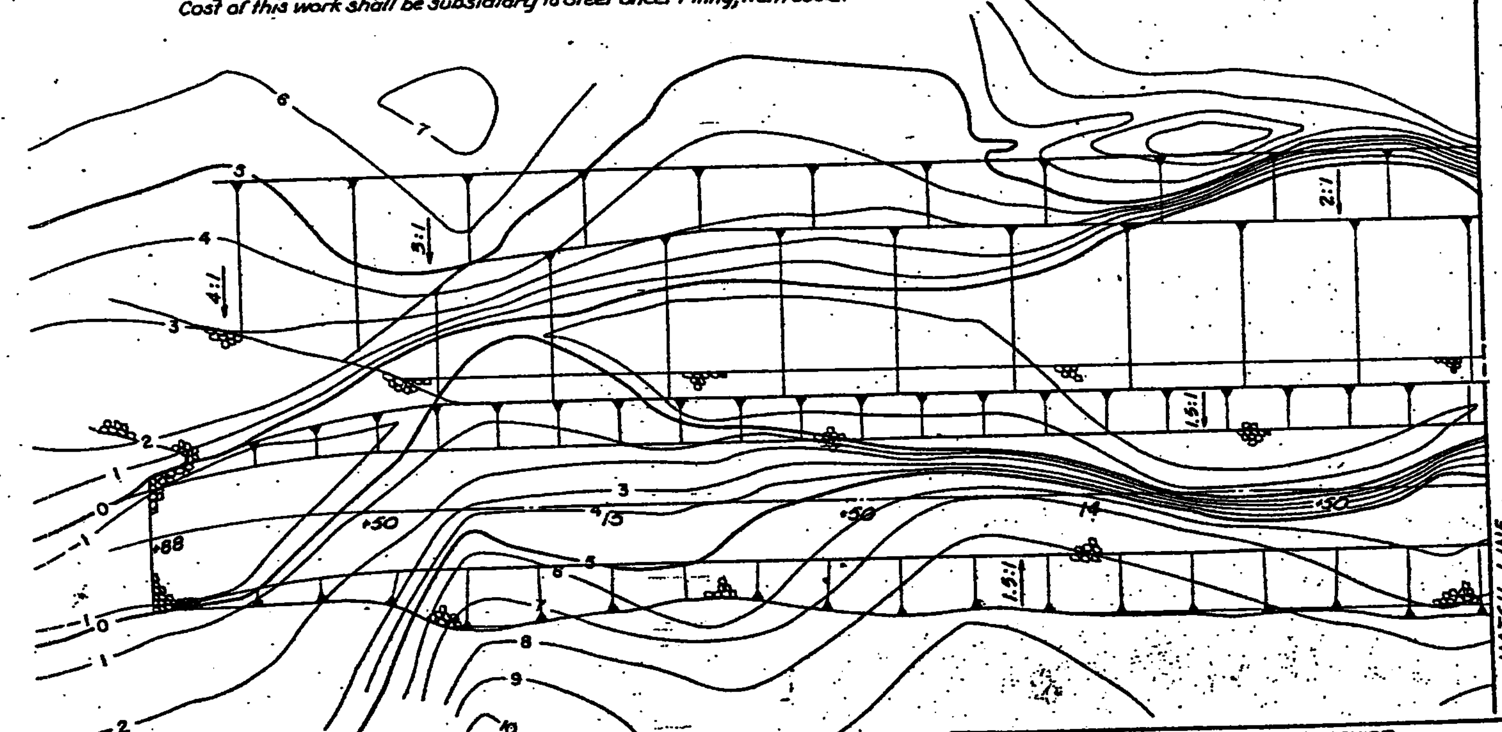
1" = 20'

NOTES

⊕ Borings made by Sprague & Henwood Inc. 221 West Olive St. Scranton, Pennsylvania, March 10, 1971. Figures in right hand column indicate number of blows required to drive 1 5/8" O.D. Open end rod one foot, using 140 lb. weight falling 2'-6". Borings are for design and show conditions at boring points only and do not necessarily indicate materials to be encountered during construction.

Indicates water level.

NOTE:
Pre-excavation and backfill with suitable material may be necessary to drive sheeting to the required elevation. Cost of this work shall be subsidiary to Steel Sheet Piling, Item 506.2.



STATE OF NEW HAMPSHIRE
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BRIDGE DESIGN DIVISION

TOWN HAMPTON — BRIDGE NO. 120/102
L.S. PROJECT 1831(2) Contract #2 — STATE PROJECT P-1238 B
LOCATION ROUTE I-95 N.B. & S.B. (E.N.H. TURNPIKE WIDENING) over TAYLOR RIVER

BORING LOGS & CONTOUR PLAN

	BY	DATE		BY	DATE
DESIGNED	I.S.	10-71	CHECKED	R.E.F.	10-71
DRAWN	S.A.L.	11-71	CHECKED	I.S.	2/72
TRACED			CHECKED		
QUANTITIES	D.I.	9-72	CHECKED	R.E.F.	9-72

BRIDGE SHEET NO. 3 OF 6

FILE NUMBER 28-3-5

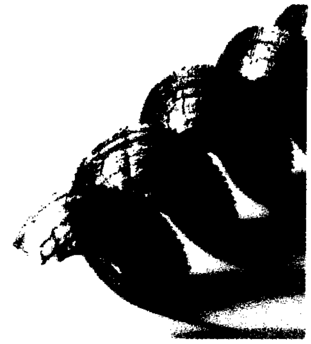
Δ	DESCRIPTION	BY	DATE

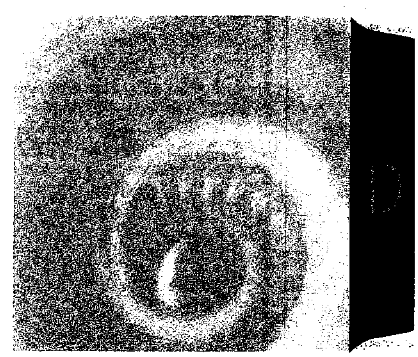
REVISIONS

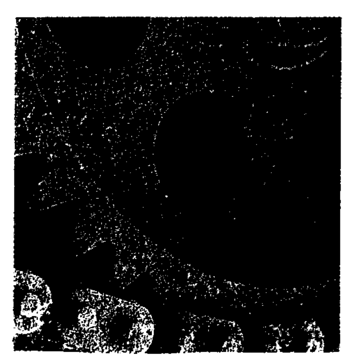
HOWARD, NEEDLES, TAMMEN & BERGENDOFF CONSULTING ENGINEERS — HNTB — BOSTON

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering







Appendix D

NHDES Dam Bureau Information on Taylor River Dam, Taylor River Relief Structure, and Rice Dam

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

DATE: January 25, 2005

FROM: Grace E. Levergood, P.E. **AT(OFFICE):** Water Division
Dam Safety Engineer GEL Dam Bureau

SUBJECT: **Taylor River Pond Dam and Taylor River Pond Dike, Hampton Falls Dam #106.08 (Haz. Class A to B) and Dike #106.09 (Haz. Class AA)**

TO: Harvey Goodwin
NH Dept. of Transportation
Bureau of Turnpikes

On July 2, 2004, the State of New Hampshire Department of Environmental Services (DES) conducted a scheduled inspection of the aforementioned dam and dike. Under the provisions of RSA Chapter 482, Sections 8 through 15, DES is authorized to inspect all dams in the State, which by reason of their physical condition, height and location may be a menace to the public safety.

The following is the result of our file reviews and site inspection:

<u>DAM #106.08</u>:

1. The sheet pile spillway was badly deteriorated with a 12" diameter hole in the downstream face adjacent to the right abutment;
2. The downstream left concrete wall of the fishway that abuts the right spillway training wall was badly deteriorated with exposed rebar and leakage;
3. Cracking was evident along the left wall of the fishway;
4. The stoplog bay sill which forms the crest of the spillway was deteriorated;
5. There was settlement of the left abutment adjacent to the sheet pile training wall;
6. There is no operation and maintenance plan (O&M) on file with the DES; and
7. An Emergency Action Plan (EAP) is now required due to the reclassification of this structure.

DES is recommending the following:

1. Make repairs to the steel sheet piling in the following locations:
   a. The spillway face
   b. The crest of the sheet pile spillway
   c. The left abutment wall which are badly deteriorated;
2. Make concrete repairs to the fishway in the following locations:
   a. The downstream left concrete wall of the fishway that abuts the right spillway training wall, is badly deteriorated with exposed rebar and leakage;
   b. The left wall of the fishway that is badly cracked;
3. Bring the left earthen embankment level with the left abutment wall where there is settlement;

4. Complete and submit to DES an O&M plan. Refer to the enclosed guidelines; and

5. Submit a draft EAP. Contact Ms. Bethann McCarthy for assistance with completing this document.

The dam was automatically classified as a low hazard, Class A dam due to its structural height being greater than 6 feet and the maximum storage behind the dam being greater than 50 acre-feet. However, upon examining the structure, the road embankment of Interstate 95 forms the dam. A failure of the primary spillway may cause minor damage to I-95. For this reason and according to Env-Wr 101.05 (d), the dam should be classified as a significant hazard, class B dam.

DES also recommends that Dam #106.09 be combined with #106.08 as one dam number due to the juxtaposition of the dams and our general policy to make immediately adjacent structures one.

Dike #106.09:

1. There was brush along the upstream face of the dam in the vicinity of the road culvert; and

2. There is no operation and maintenance plan (O&M) on file with the DES.

DES is recommending the following:

1. Remove the brush from the upstream face of the dam in the vicinity of the road culvert; and

2. Complete and submit to DES an O&M plan. Refer to the enclosed guidelines.

In lieu of repairs to both the dam and dike, removal of the dam should be considered. A meeting was held on January 4, 2005 at NH Department of Transportation (DOT) in Concord to discuss proposed culvert replacement at the emergency spillway and fisheries issues. (See attached memo)

We strongly recommend that any dam repair activities, either to address the items noted above or otherwise, be coordinated with the Dam Safety Section of DES's Dam Bureau. Additionally, should any of these items result in a change in the structural configuration, height, length, or discharge capacity of the dam, a reconstruction permit will be required from the Dam Bureau. Likewise, should completion of any of these items fall under the jurisdiction of the Wetlands Bureau, an application to dredge or fill in the waters of the State may be necessary. If you have any questions relative to the aforementioned findings, please do not hesitate to inquire. Thank you.

Attachments: Sketch Illustrating Deficiencies, Guideline for an O&M plan, memo
cc: Mark Kirorac, NHF&G
Jim Gallagher, P.E., Chief Water Resources Engineer
Jimmy Leung, P.E., Maintenance Section
Bethann McCarthy, P.E., EAP Coordinator
John Nelson, Chief of Marine Fisheries, NHF&G
GEL/was/h:/safety/wendy/memo/10608&09mem2005.doc

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

FROM: Grace Levergood, P.E. gel
Dam Safety Engineer
Dam Bureau

DATE: January 12, 2005
AT: Environmental Services
Water Division

SUBJECT: Taylor River Pond Dam, Hampton Falls, NH
Dam #106.08

ATTENDEES: Kevin Nylan, Wayne Brooks, Bill Hauser – DOT
Cheri Patterson, NHFG
Grace Levergood, Ted Diers, Jen Droziak - DES

A meeting was held on January 4, 2005 at NH Department of Transportation (DOT) in Concord to discuss proposed culvert replacement at the Taylor River Pond Dam emergency spillway and fisheries issues. Plans are underway at DOT to line the badly corroded CMP pipe arch culvert that goes under I-95 from the emergency spillway by September 2005. The culvert was inspected by a DOT consultant and found to be in very poor shape. Although not inspected at the same time, the bridge under I-95 at the main spillway is also suspected to be in need of repairs due to its sheet pile make-up. Suggestions were made to forego the repair work on the CMP pipe arch culvert and use the money towards another project. A proposed feasibility study would look at the option of replacing the main spillway with a natural fishway and possibly eliminating the need for the emergency spillway and pipe arch culvert.

NHFG commented that the fish ladder does not function as intended. Also fish are trying to move up the pipe arch culvert with ends at the emergency spillway and has no fish passage instead of moving further upstream to the fish ladder at the main spillway. See the attached NHFG report that discusses the drastic decline in fish passed by the ladder as well as the degraded water quality in the pond upstream of the dam.

Next steps will include:

- Ted Diers of the DES Coastal Program will have Milone & MacBroom and Dick Quinn of USFWS will examine the site and give their expert advice on fish passage.
- DES Dam Bureau will issue their dam safety inspection report to DOT.
- DES and NHFG will develop a dam removal/fish passage concept to DOT.

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Taylor River Dam and Fish Ladder

Diadromous fish were denied access to freshwater portions of New Hampshire's coastal rivers to complete their life cycle with the construction of dams in the nineteenth century. The construction of six fishways on five coastal rivers in the late 1960's and early 1970's (Exeter, Lamprey, Oyster, Cocheco and Taylor Rivers) provided anadromous fish access to many acres of freshwater spawning and nursery habitat. Deterioration of these structures due to normal aging make it necessary to assess their effectiveness in passing fish and the reason for impounding water.

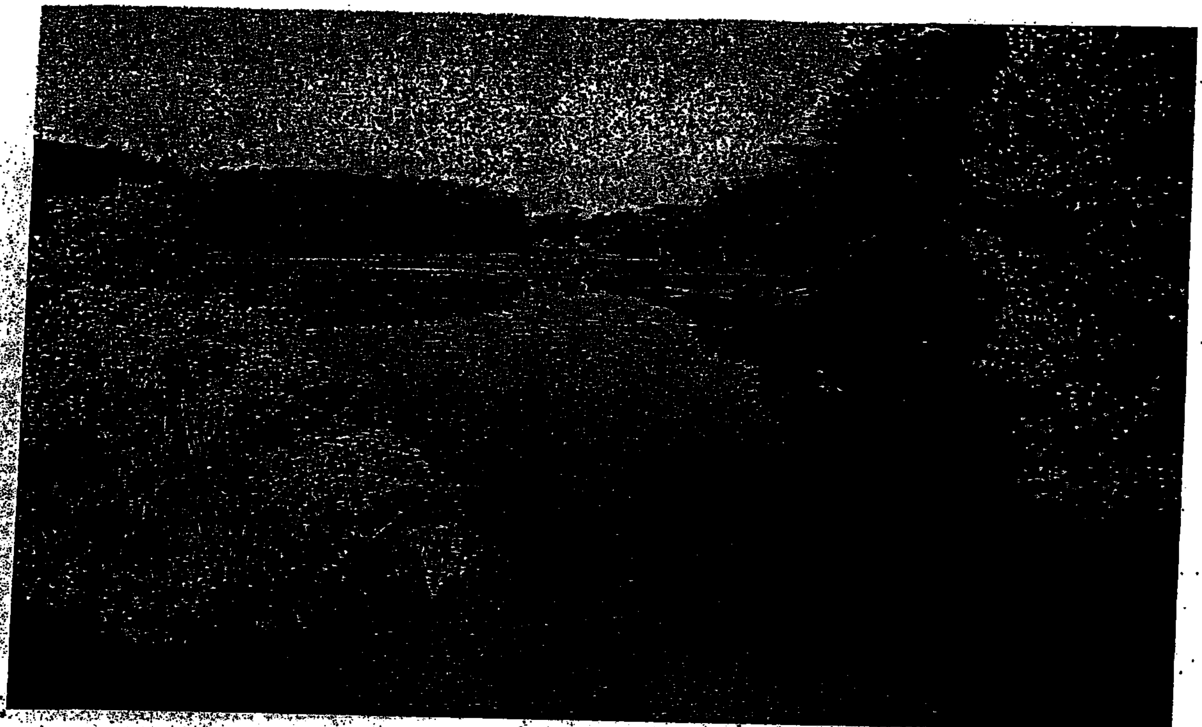
The majority of anadromous fish using the fishways in the spring are alewife and blueback herring (river herring). Adult and juvenile river herring are a very important forage fish for inland, estuarine, and coastal species. For example, juvenile river herring provide a forage base within inland rivers and lakes for such freshwater species as bass and pickerel. In addition, juveniles and adults migrating between the ocean and natal rivers are preyed upon by many sportfish (striped bass, bluefish, etc.) within the Great Bay and Hampton/Seabrook Estuaries. Also, fishermen net adult river herring during the spring spawning run to be used as bait for sport fishing or lobster.

The Taylor River in Hampton/Hampton Falls, New Hampshire has 45 acres of available spawning and nursery habitat between the head of tide dam and next upstream dam. This river system has experienced the most dramatic decline in river herring spawning runs than any other coastal river. The Taylor River had the highest recorded river herring runs (1976 passed 450,000 river herring) in coastal New Hampshire rivers but now is one of the lowest runs (2003 passed 1,300 river herring). This impoundment also has indications of potential water quality concerns as noted in the following pictures with the large growth of algae and weeds during the summer months.

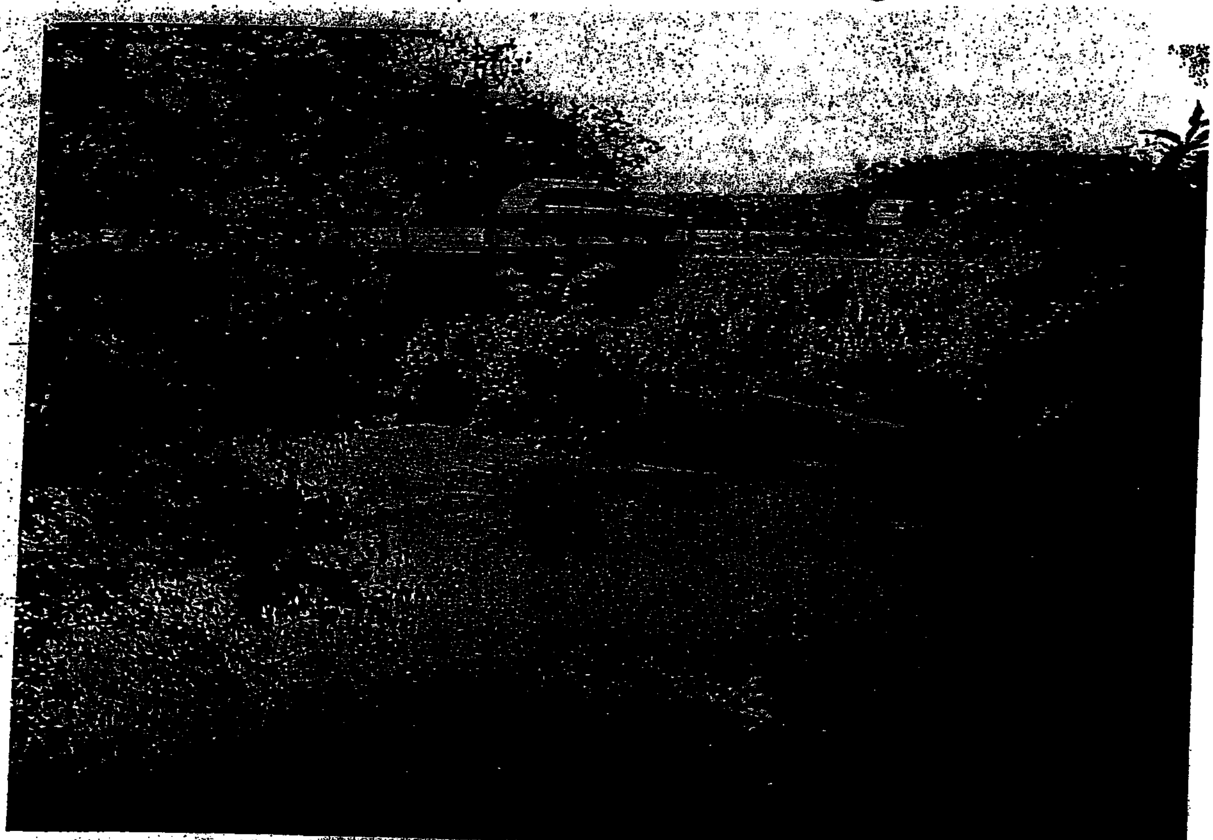
Currently, portions of the cement walls in the Taylor River fish ladder contain substantial holes that allow water to escape thereby reducing its efficiency in attracting and passing a variety of diadromous fish. The Department of Transportation (DOT) owned concrete and steel dam adjacent to I95 also is in severe disrepair that is affecting the integrity of this class A dam. A Department of Environmental Services (DES) dam inspection has been initiated and the final report will be given to DOT in late 2004. At this point New Hampshire Fish and Game, DES and DOT hope to confer on the next logical steps to be taken to remedy this situation of deteriorated structures, water quality and viable habitat for diadromous species utilizing this river system. This may be in the form of repairing the structures or dam removal.

Since the remedial process is still in the early stages between all agencies involved there is no definitive agreement on how to proceed with a grant award towards this project. This should be better defined by spring of 2005.

Picture 1. Taylor River impoundment – upstream of dam (west side of I95) – August 2004



Picture 2. Taylor River fish ladder exit – West side of I95 – August 2004

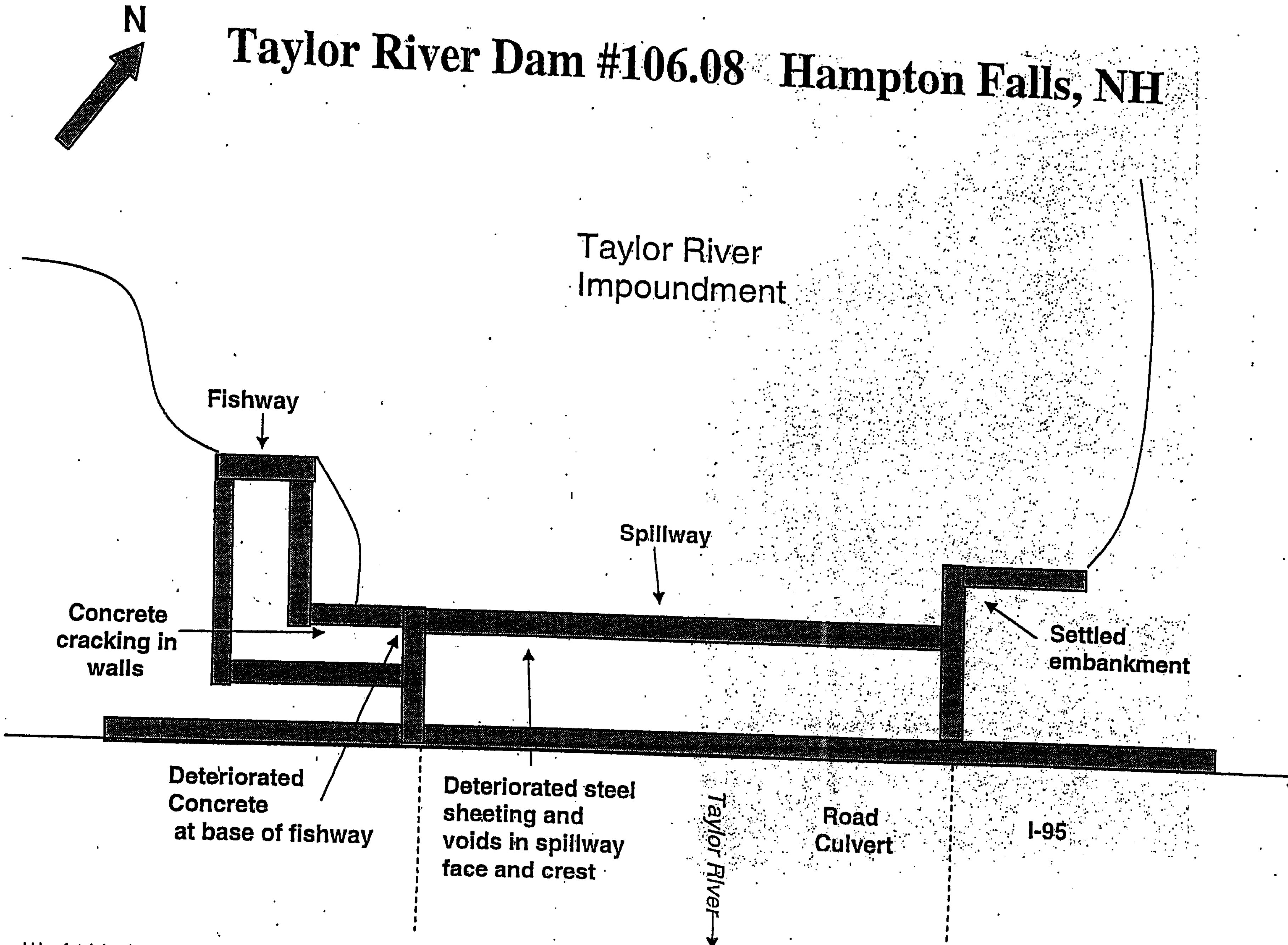


Picture 3. Taylor River dam – water flowing through hole in dam alongside fish ladder entrance – November 2004.

Picture 4. Taylor River dam – two holes on top lip of dam on opposite side of fish ladder entrance – November 2004.

Picture 5. Taylor River fish ladder – deterioration at entrance of fish ladder – August 2004.

Taylor River Dam #106.08 Hampton Falls, NH



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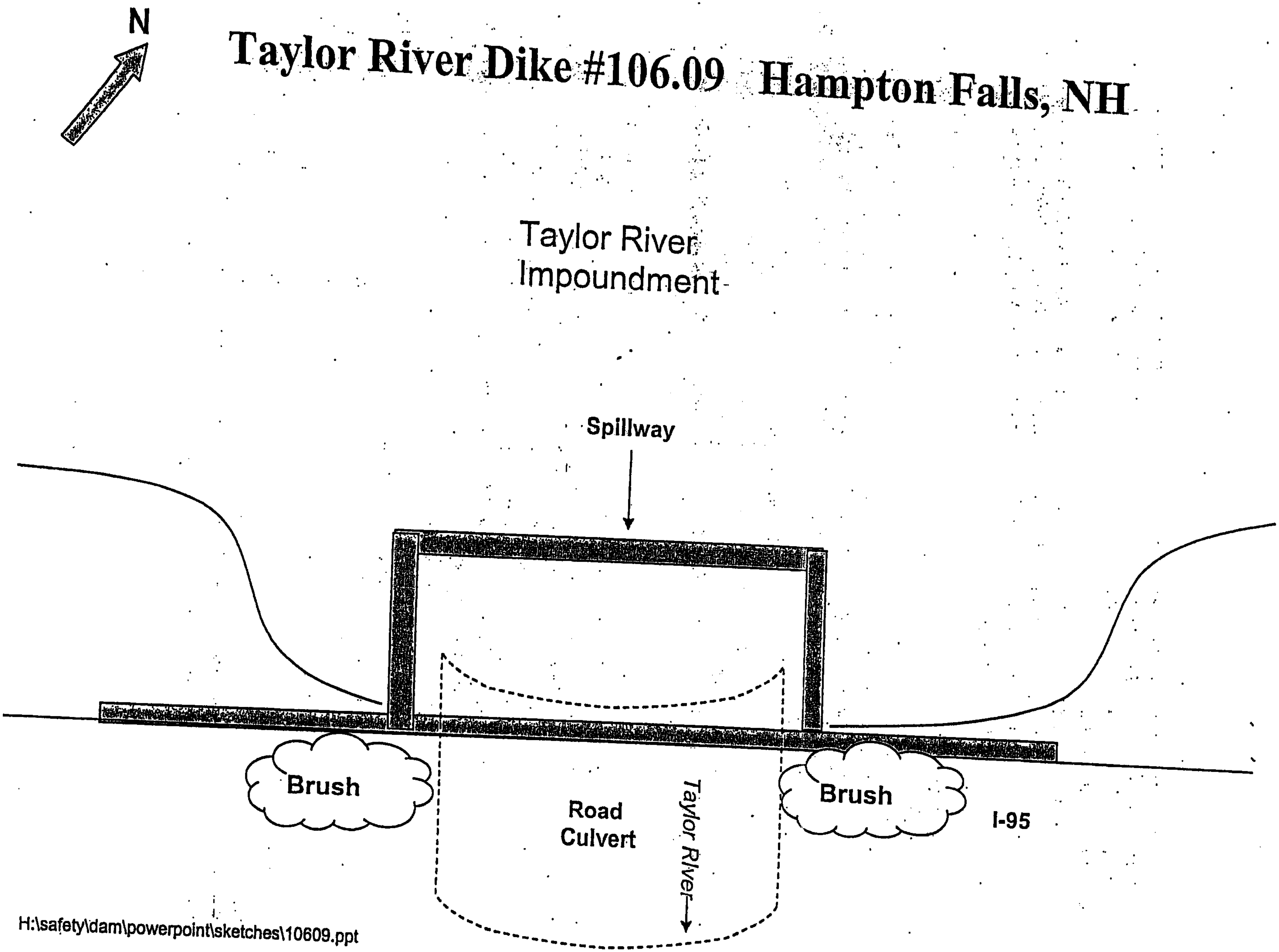
Taylor River Dike #106.09 Hampton Falls, NH



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January 5, 2005

STATE OF NEW HAMPSHIRE
DEPARTMENT OF TRANSPORTATION
BUREAU OF HIGHWAY DESIGN

CONFERENCE REPORT

PROJECT: Statewide Culvert Repairs
IM-X-000S(397)
13408
(Various locations throughout the state on Interstate and Turnpike systems)

DATE OF CONFERENCE: January 4, 2005

LOCATION OF CONFERENCE: Aeronautics Conference Room

ATTENDED BY:

NHDOT	NHDES	NH Fish and Game
K. Nyhan	Ted Diers, NH Coastal Program	Cheri Patterson, Marine Fisheries
W. Brooks	Jen Drociak, NH Coastal Program	
. Hauser	Grace Levergood, Dam Bureau	

SUBJECT: Hampton over-flow structure at the Taylor River outlet

NOTES ON CONFERENCE:

Mr. Brooks provided some background information on the project highlighting the statewide culvert inspection that was done under an earlier contract with Louis Berger Group. He noted that the current contract was intended to address the culverts that were in the worst condition and in need of immediate repair. He noted that the scope of work for this project was to slip-line the existing 6'-1" high x 8'-10" wide steel plate pipe-arch culvert with a smooth interior plastic pipe at a cost of about $200,000. Mr. Brooks noted that the Department has considered the culvert structure to be a separate structure apart from the Bridge and dam 300' north of the culvert. It was noted that NHDES considers the Taylor River outlet to consist of two structures, the dam and the overflow structure, each having an identifying number.

Mr. Brooks noted that Turnpikes has reviewed the structures and recognizes their current poor condition. The existing bridge consists of driven steel sheet piling 15' wide, 10' high with a concrete deck. The dam is immediately upstream of the bridge, also being constructed of driven sheet piling, and is integrated with the bridge structure. There is also a fish ladder that is part of the dam structure, allowing for migration of fish from the salt water to fresh water river networks. Turnpikes has noted that the dam has undergone repairs in the past, correcting corrosion problems.

Ms. Patterson noted that the dam connected to the bridge structure is in very poor condition having many leaks and holes. She stated that the leakage of the dam has undermined the fish ladder, causing concrete spawling. Ms. Levergood stated that the recent inspection report has not been sent to Turnpikes t, but will indicate the dam to be in very poor condition and in need of major repairs in the near future. Mr. Diers indicated that NHDES has some money and is seeking additional funding for a comprehensive study of the Taylor River watershed and would like to address the dam and fish ladder to improve fish passage through the structure(s). It was noted that NH F&G and DES are planning on bringing experts in fish passage to conduct a preliminary study over the next couple months, a study which will help to identify the potential alternatives to look at in a more comprehensive analysis." Ms. Levergood noted that the

hydrologic model indicated that the secondary pipe-arch may not be necessary with a redesign of the dam structure. It was requested that the Department consider delaying performing work on this culvert until a design for the new dam structure is known and possibly divert the current project funds to this end. Mr. Brooks noted that addressing the dam would likely require also addressing the bridge structure, which would require much more work and funding than is currently available. Mr. Hauser noted that the Ten Year Plan did not currently have a project dedicated to replacing the bridge. He also noted that a considerable amount of the cost would be for traffic control. Mr. Brooks agreed to review the possibility of an interim treatment to the culvert, lasting up to five years to allow for completion of the study. This may save much of the original project cost. Mr. Brooks will discuss this again with Turnpikes and Project Development once the dam inspection report is available. Mr. Brooks noted that if the study revealed a larger project, including complete bridge replacement then replacing the culvert may be necessary. It was agreed that it would be desirable to save the cost of the culvert repair if replacing the other structures is imminent.

Submitted by:

Wayne Brooks

Wayne Brooks
Consultant Supervisor

WPB/wpb/

Noted by: W. Hauser WH, K. Nyhan KN, T. Diers TD
cc: K. Cota, J. Moore, M. Pillsbury, H. Goodwin
S:\STATEWID\13408\CONFRPTS\102004.DOC

Type of Action
✓ Regular Inspection
___ Follow-up Inspection
___ Post-const. Inspection
Other___________________

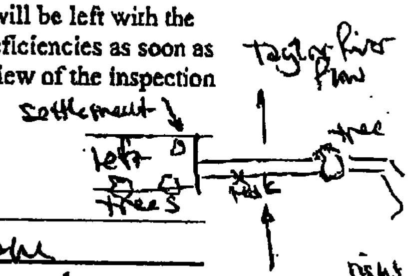
NH Department of Environmental Services
29 Hazen Drive
PO Box 95
Concord, NH 03302-0095
(603) 271-3406
web site: www.des.state.nh.us

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

SITE INSPECTION FORM

Dam Name: Taylor River Pond Dam #: 106.06 Town: Hampton Falls
Date: 7/2/04 Owner: Fran Rice

The following is a listing of findings and, if appropriate, recommendations based upon the evaluation associated with the above referenced dam. The owner or his/her representative should implement the recommendations listed on this form, which are aimed at improving the safety of the dam. This form, a copy of which will be left with the owner or owner's representative, is intended to make dam owners aware of easily correctible deficiencies as soon as an inspection is carried out. More formal compliance notices may be issued after a detailed review of the inspection notes and photographs has been made.



Inspection Findings & Recommendations:

Remove trees and brush
(1) Brush and trees on left abutment of dam
2 trees measured greater than 12" diameter
Tree along downstream face of dam to the left of lowlevel gate

(2) Leakage noted in several locations along upstream spillslab - water migrating beneath concrete slab through stonework - unable to maintain normal pool level in pond.

(3) Left abutment and earth interface has settled and cracked.

(4) Concrete cap on spillway is cracked and deteriorated

(5) Please complete an operation and maintenance plan and submit to DES - refer to guidelines.

(6) Exercise lowlevel gate (in fall)
(7) Sediment buildup in impoundment.

(9) In place of repair consider dam removal - Contact Stephanie Lindloff at #271-3406 funding may be available.

Owner/Owner Representative:_______________ Form left w/Owner/Rep?: yes no

DES Inspector: Grace Levergood

Please contact Inspector with any questions.

Distribution: WHITE – File YELLOW – Owner/Rep. PINK - Inspector

Idylwe River Park Dam 1106.06 | 11-24-04 OZC

FILE | REVIEW

wasteli0.apr

AO issued 10/28/92

COO issued 6/3/98

DA = 9.75 mi² | 8.47 mi²

HT = 14 ft

LENGTH = 125 ft

SA = 6.3 AC | 6.3 AC

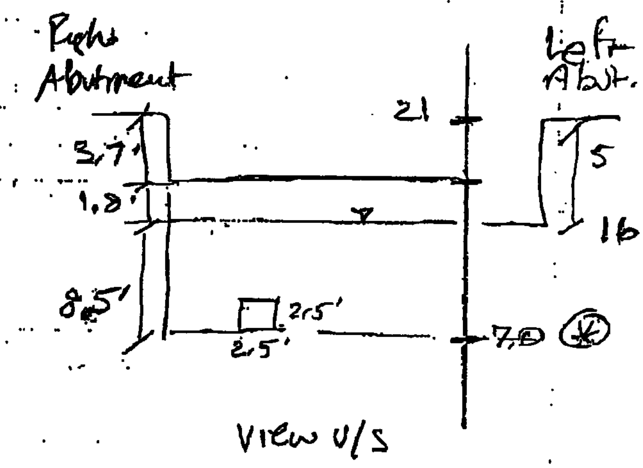
Q50 = 903 cfs
432 cfs → Potters

Qdesh = 2165 cfs

HydroCAD ver 6.0
492 cfs in
463 cfs out
pk elev = 18.17'

OUTLETS

1 - 52' w. x 5' h spillway
1 - 10' w x 3.7' h spillway
1 - 2.5' x 2.5' low level gate

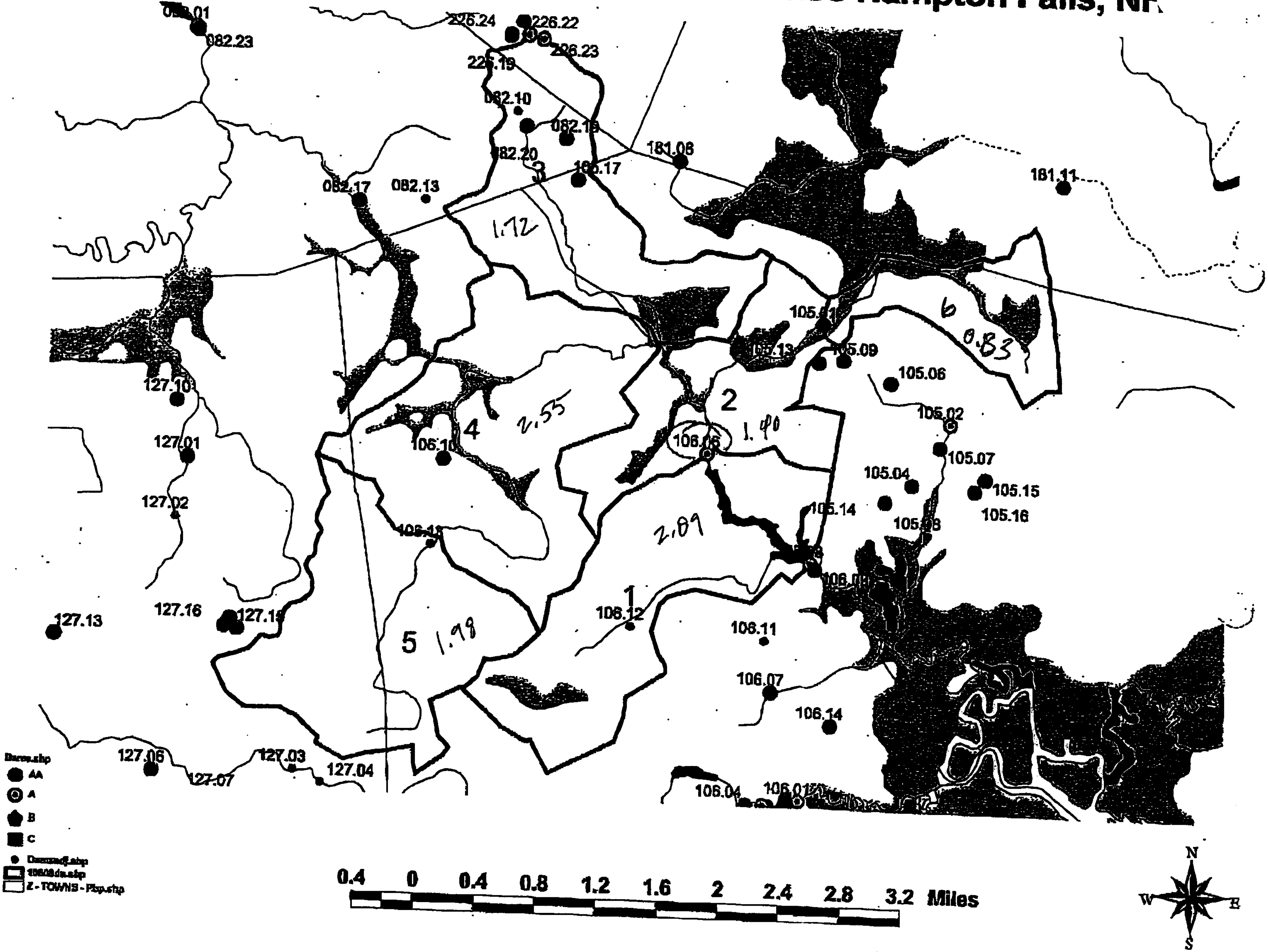


STORAGE	ELEV	SA	AC-FT	FILE
MAX	21	10	10(5) + 18.7 = 68.7	60.8
PERM	16	6.3	0.33(9) 6.3 = 18.7	20.8
BOT	7	0		

Brown Rd
D/S Bridge 250' d/s 2 - 12' w x 12.5' h openings
INV = 14'

(*) BA = 6.5 m USGS map = 21.3'

#106.08 Hampton Falls, NH



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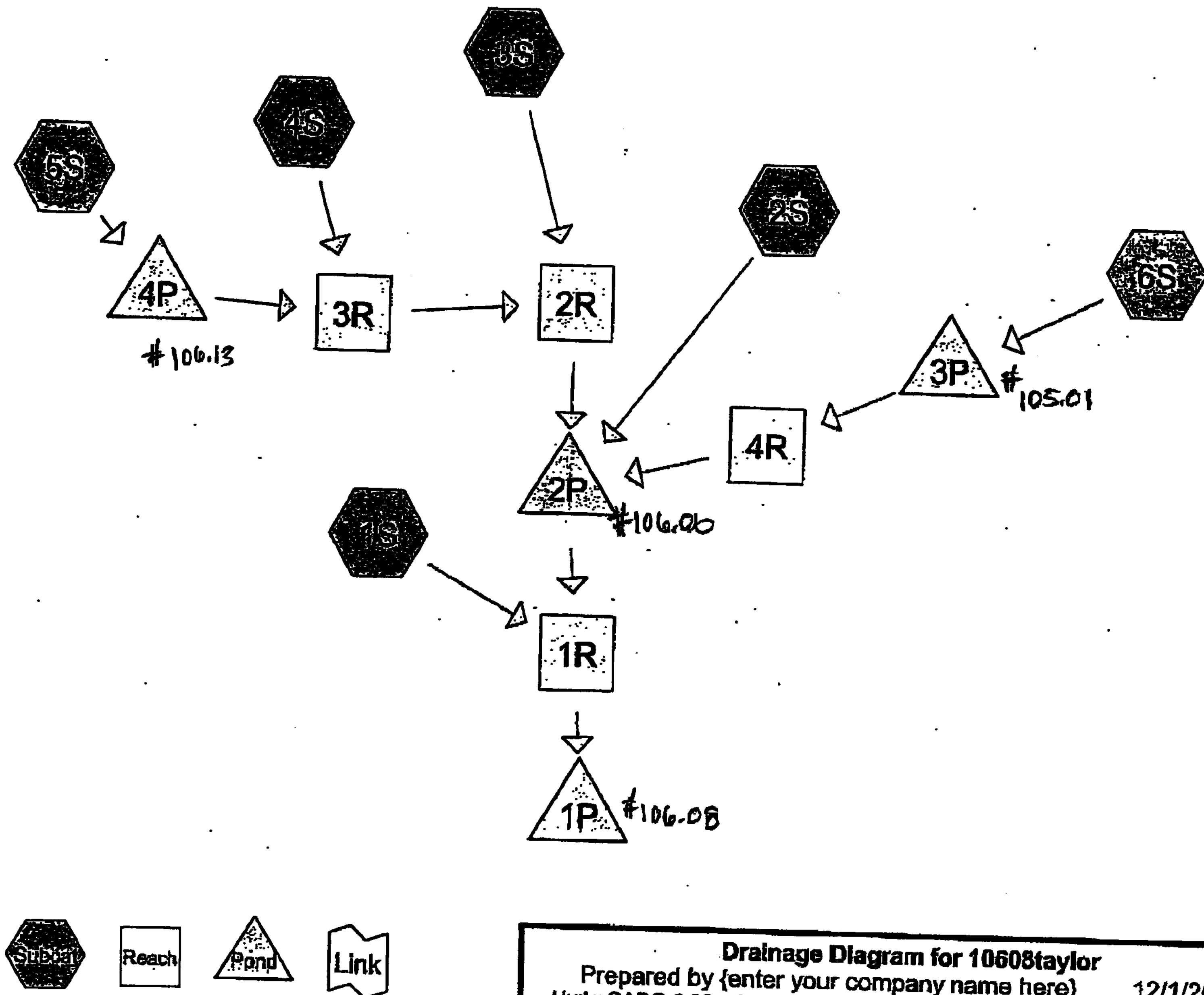


Drainage Diagram for 10608taylor
Prepared by {enter your company name here} 12/1/2004
HydroCAD® 6.00 s/n 001850 © 1986-2001 Applied Microcomputer Systems

Pond 2P: Taylor River Pond Dam #106.06

Inflow	=	492.32 cfs @ 20.00 hrs, Volume=	202.941 af	
Outflow	=	463.40 cfs @ 20.00 hrs, Volume=	181.177 af,	Atten= 6%, Lag= 0.0 min
Primary	=	463.40 cfs @ 20.00 hrs, Volume=	181.177 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Starting Elev= 16.00' Storage= 19.000 af
Peak Elev= 18.17' Storage= 40.705 af (21.705 af above starting storage)
Flood Elev= 21.00' Storage= 69.000 af (50.000 af above starting storage)
Plug-Flow detention time= 77.0 min calculated for 161.638 af (80% of inflow)

Elevation (feet)	Cum.Store (acre-feet)
7.00	0.000
16.00	19.000
21.00	69.000

Primary OutFlow (Free Discharge)
—1=Broad-Crested Rectangular Weir
—2=Broad-Crested Rectangular Weir

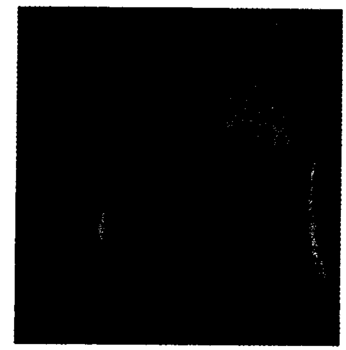
#	Routing	Invert	Outlet Devices
1	Primary	16.00'	**52.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.9
2	Primary	17.80'	**10.0' long x 3.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.9

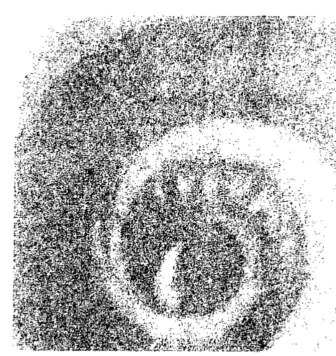
Pond 2P: Taylor River Pond Dam #106.06

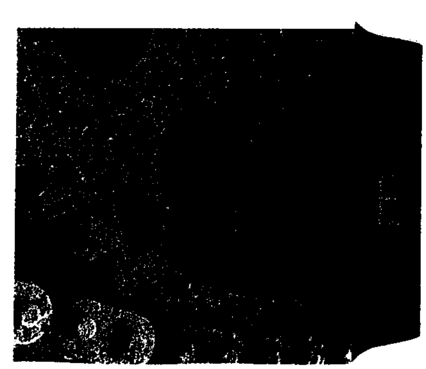
Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
7.00	0.00	14.80	0.00
7.15	0.00	14.95	0.00
7.30	0.00	15.10	0.00
7.45	0.00	15.25	0.00
7.60	0.00	15.40	0.00
7.75	0.00	15.55	0.00
7.90	0.00	15.70	0.00
8.05	0.00	15.85	0.00
8.20	0.00	16.00	0.00
8.35	0.00	16.15	7.37
8.50	0.00	16.30	21.45
8.65	0.00	16.45	40.89
8.80	0.00	16.60	64.77
8.95	0.00	16.75	90.26
9.10	0.00	16.90	118.10
9.25	0.00	17.05	148.12
9.40	0.00	17.20	180.46
9.55	0.00	17.35	215.33
9.70	0.00	17.50	254.11
9.85	0.00	17.65	295.37
10.00	0.00	17.80	336.55
10.15	0.00	17.95	385.15
10.30	0.00	18.10	437.40
10.45	0.00	18.25	493.12
10.60	0.00	18.40	552.26
10.75	0.00	18.55	614.69
10.90	0.00	18.70	681.13
11.05	0.00	18.85	750.78
11.20	0.00	19.00	823.69
11.35	0.00	19.15	894.66
11.50	0.00	19.30	968.46
11.65	0.00	19.45	1,044.80
11.80	0.00	19.60	1,126.73
11.95	0.00	19.75	1,214.19
12.10	0.00	19.90	1,304.84
12.25	0.00	20.05	1,405.06
12.40	0.00	20.20	1,522.66
12.55	0.00	20.35	1,645.79
12.70	0.00	20.50	1,774.63
12.85	0.00	20.65	1,870.00
13.00	0.00	20.80	1,967.26
13.15	0.00	20.95	2,065.38
13.30	0.00		
13.45	0.00		
13.60	0.00		
13.75	0.00		
13.90	0.00		
14.05	0.00		
14.20	0.00		
14.35	0.00		
14.50	0.00		
14.65	0.00		

GEI Consultants

Geotechnical
Environmental and
Water Resources
Engineering







Appendix E

NHDES Water Well Data

Table E1. 'Water Well Data, Wells in NHGS GIS System and Within 1/4-Mile of Pond
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

WRB#	LIC#	WELL#	ELEV	LAT	LONG	DECMINY	DECMINX	LOCENT	LOCACC	LNAME	ST#	ROAD	ROAD2	TOWN	MAP
105.0004	141	310	60	425643	705215	4256.718575	7052.216494	1	4	SCANLON	103	TIMBER SWAMP RD	99999	HAMPTON	119
105.0005	315	106	17	425615	705202	4256.247793	7052.000706	1	1	FINCKE	99999	PRESCOTT LN	99999	HAMPTON	105
105.0006	177	675	39	425623	705203	4256.395855	7052.026350	1	1	RJ LAVIN CO	99999	CAMPBELL DR	99999	HAMPTON	99999
105.0014	177	343	40	425623	705217	4256.390496	7052.252377	1	4	LAMSON	246	TOWLE FARM RD	99999	HAMPTON	99999
105.0025	177	740	62	425626	705200	4256.445431	7051.975516	1	1	RJ LAVIN CO	99999	CAMPBELL DR	99999	HAMPTON	99999
105.0042	177	988	48	425624	705201	4256.397944	7051.985991	1	1	R J LAVIN CO	99999	CAMPBELL DR	99999	HAMPTON	99999
105.0046	177	44	54	425623	705158	4256.393857	7051.943022	1	1	R J LAVIN CO	99999	CAMPBELL DR	99999	HAMPTON	99999
105.0052	177	131	68	425626	705158	4256.430651	7051.928877	1	1	LAVIN	99999	CAMPBELL DR	99999	HAMPTON	99999
105.0060	406	2469	13	425611	705211	4256.195617	7052.150827	1	1	WHITESIDE	99999	HICKORY LN	99999	HAMPTON	99999
105.0064	406	2163	40	425620	705219	4256.340033	7052.281834	1	2	BRADLEY	254	TOWLE FARM RD	99999	HAMPTON	169
105.0077	243	108	13	425614	705215	4256.238199	7052.223097	1	2	WHITESIDE	99999	HICKORY LN	99999	HAMPTON	170
105.0100	177	691	21	425616	705221	4256.276848	7052.321858	1	2	PAUL	286	TOWLE FARM RD	99999	HAMPTON	169
105.0161	177	1088	65	425628	705224	4256.471738	7052.372681	1	2	STICHNEY	151	TIMBER SWAMP RD	99999	HAMPTON	154
105.0169	406	99999	13	425612	705211	4256.205984	7052.150245	1	2	OGRADY	99999	99999	99999	HAMPTON	170
106.0027	644	12585	40	425559	705228	4255.991765	7052.434206	1	4	R W BRIDLE	49	BROWN RD	99999	HAMPTON FALLS	5
106.0097	177	928	44	425622	705257	4256.376212	7052.917942	1	2	ROMONOSKI	27	OLD STAGE RD	99999	HAMPTON FALLS	5
106.0214	1236	9759	40	425628	705258	4256.469155	7051.934015	1	2	MURPHY	26	OLD STAGE RD	99999	HAMPTON FALLS	5
106.0249	1	4835	31	425630	705247	4256.506708	7052.756968	1	1	NORTHWAY BUILDERS	99999	OLD STAGE RD	99999	HAMPTON FALLS	99999
106.0251	3	02925	13	425612	705234	4256.205000	7052.537000	5	52	PARISH	99999	TOWLE FARM RD	99999	HAMPTON FALLS	99999
106.0252	177	1094	33	425558	705226	4255.965035	7052.400921	1	2	TUCKER	99999	BROWN RD	99999	HAMPTON FALLS	5
106.0257	1236	99999	45	425600	705246	4256.009324	7052.737764	1	2	RYBINSHI	99999	BROWN RD	99999	HAMPTON FALLS	5
106.0266	364	364-010223RT1	18	425621	705239	4256.351249	7052.620252	1	2	GREEN & CO	8	BATHCELDER DR	0	HAMPTON FALLS	5
106.0267	364	364-011002TW3	19	425623	705239	4256.394907	7052.627313	1	2	GREEN & CO	99999	GOVERNORS RIDGE RD	0	HAMPTON FALLS	5
106.0270	364	364-010605TW5	17	425629	705241	4256.494751	7052.658079	1	1	GREEN & CO	99999	GOVERNORS RIDGE RD	0	HAMPTON FALLS	99999
106.0281	177	1220	23	425553	705226	4255.896267	7052.397995	1	2	MIST DEVEL	99999	BROWN RD	99999	HAMPTON FALLS	5
106.0282	177	1849	34	425557	705237	4255.963191	7052.581746	1	2	MORGADO	60	BROWN RD	99999	HAMPTON FALLS	5
106.0288	177	1920	38	425559	705229	4255.994708	7052.454311	1	2	JARRAD PATTON	53	BROWN RD	99999	HAMPTON FALLS	5
106.0312	225	03334	99999	99999	99999	4255.867000	7052.336000	5	52	WILLOW RIVER FARM LLC	99999	BROWN RD	99999	HAMPTON FALLS	99999
106.0313	225	03336	99999	99999	99999	4256.191000	7052.494000	5	52	RIVER WILLOW FARM LLC	99999	TOWLE FARM RD	99999	HAMPTON FALLS	99999
106.0317	1085	99999	10	425609	705228	4256.152110	7052.428543	1	2	JARROD PATTON	9	TOWLE FARM RD	99999	HAMPTON FALLS	5
106.0322	364	030715RT2	45	425620	705259	4256.344714	7052.958002	1	2	GREEN AND CO	23	OLD STAGE RD	0	HAMPTON FALLS	5
106.0336	1085	118-2004	99999	99999	99999	4256.467000	7052.700000	5	52	VANDERELS	37	OLD STAGE RD	99999	HAMPTON FALLS	99999
106.0342	1236	99999	15	99999	99999	4255.919000	7052.220000	5	52	AMBERWOOD REALITY CORP	99999	MARSTON RD	0	HAMPTON FALLS	99999

Table E1. 'Water Well Data, Wells in NHGS GIS System and Within 1/4-Mile of Pond
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

WRB#	PARCEL	DCOMP	USE	RSN	TYPE	TOTD	BDKD	CASING	YTM	YTD	YTQ	SWL	DMEAS	OB	HF	HF_BEFORE	GROUTED	NOTE
105.0004	0	12-OCT-1986	1	1	1	230.00	11.00	20.00	3	0.50	30.00	8.00	99999	4	99999	99999	99999	99999
105.0005	9	30-SEP-1986	1	1	1	335.00	53.00	71.00	3	0.50	18.00	15.00	31685	12	99999	99999	99999	YL
105.0006	0	31-JUL-1987	1	1	1	340.00	5.00	21.00	3	99999.00	100.00	99999.00	99999	3	99999	99999	99999	99999
105.0014	99999	17-OCT-1985	1	1	1	400.00	9.00	21.00	3	99999.00	4.50	99999.00	99999	12	99999	99999	99999	99999
105.0025	8	26-OCT-1987	1	1	1	400.00	10.00	20.00	3	99999.00	3.50	99999.00	99999	4	99999	99999	99999	99999
105.0042	0	15-MAR-1989	1	1	1	140.00	10.00	21.00	3	99999.00	30.00	99999.00	99999	4	99999	99999	99999	99999
105.0046	0	21-JUL-1989	1	1	1	140.00	20.00	34.00	3	99999.00	20.00	99999.00	99999	14	99999	99999	99999	99999
105.0052	0	11-DEC-1989	1	1	1	300.00	2.00	17.00	3	99999.00	8.00	99999.00	99999	4	99999	99999	99999	99999
105.0060	0	08-AUG-1992	1	1	1	182.00	40.00	52.00	3	0.75	4.00	99999.00	99999	4	99999	99999	99999	YL
105.0064	2	22-JUL-1991	1	2	1	382.00	9.00	20.00	3	0.85	2.00	99999.00	99999	1	99999	99999	99999	99999
105.0077	2	25-MAY-1994	1	2	1	506.00	54.00	66.50	99999	3.00	4.00	7.00	34479	4	99999	99999	99999	YL
105.0100	7	30-MAY-1995	1	1	1	400.00	40.00	51.00	3	0.50	3.00	99999.00	99999	4	99999	99999	99999	99999
105.0161	2	25-SEP-1998	1	1	1	220.00	23.00	40.00	3	0.50	7.00	99999.00	99999	2	99999	99999	99999	99999
105.0169	8	06-OCT-1999	1	1	1	60.00	31.00	50.00	3	1.00	30.00	9.00	36439	4	99999	99999	99999	99999
106.0027	54	25-JUN-1985	1	1	1	300.00	45.00	59.00	3	3.00	1.50	99999.00	99999	3	99999	99999	99999	YL
106.0097	0	04-OCT-1988	1	1	1	400.00	24.00	40.00	3	99999.00	2.00	99999.00	99999	12	99999	99999	99999	99999
106.0214	0	01-OCT-1997	1	2	1	340.00	17.00	33.00	3	1.00	7.00	99999.00	99999	4	99999	99999	99999	YL
106.0249	99999	21-SEP-2000	1	1	1	140.00	19.00	41.00	3	1.00	25.00	99999.00	99999	123	99999	99999	99999	99999
106.0251	99999	15-JUL-2000	1	1	1	623.00	35.00	71.00	3	1.00	12.00	10.00	36723	3	0	2	99999	99999
106.0252	54	26-MAY-2000	1	1	1	120.00	12.00	20.00	3	0.50	25.00	99999.00	99999	4	99999	99999	99999	99999
106.0257	11	10-AUG-2000	1	2	1	220.00	51.00	60.00	3	1.00	7.50	20.00	36760	3	99999	99999	99999	YL
106.0266	0	20-FEB-2001	1	1	1	140.00	10.00	24.00	3	0.50	20.00	5.00	36942	4	99999	99999	99999	99999
106.0267	0	25-SEP-2001	1	1	1	420.00	10.00	25.00	1	99999.00	8.00	15.00	37159	24	99999	99999	99999	DEVELOPED BY SURGING
106.0270	0	06-JUN-2001	1	1	1	240.00	15.00	30.00	3	0.50	10.00	12.00	37048	4	99999	99999	99999	99999
106.0281	6	20-AUG-2001	1	1	1	440.00	11.00	20.00	3	0.50	3.50	99999.00	99999	3	99999	99999	99999	99999
106.0282	8	11-JUN-2002	1	1	1	340.00	25.00	40.00	3	0.50	8.50	99999.00	99999	3	99999	99999	99999	99999
106.0288	0	31-OCT-2002	1	1	1	320.00	23.00	40.00	3	0.50	15.00	99999.00	99999	3	99999	99999	99999	99999
106.0312	99999	12-SEP-2003	1	1	1	240.00	12.00	40.00	3	1.00	60.00	99999.00	99999	24	99999	99999	99999	99999
106.0313	99999	14-SEP-2003	1	1	1	410.00	9.00	40.00	3	1.00	50.00	99999.00	99999	3	99999	99999	99999	YL
106.0317	0	23-AUG-2003	1	1	1	550.00	11.00	30.00	3	0.50	16.00	99999.00	99999	4	99999	99999	99999	99999
106.0322	0	03-JUL-2003	1	1	1	420.00	12.00	30.00	3	0.75	12.00	12.00	37805	24	99999	99999	99999	99999
106.0336	99999	18-OCT-2004	1	2	1	220.00	30.00	50.00	3	0.50	15.00	20.00	38279	12	99999	99999	99999	YL
106.0342	0	19-NOV-2004	1	1	1	500.00	20.00	40.00	3	0.50	30.00	99999.00	99999	13	99999	99999	99999	YL

Table E2. Water Well Data, Wells in NHGS Database but Not in GIS System, Within 1/4-Mile of Pond
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

WRB#	LIC#	WELL#	ELEV	LAT	LONG	DECMINY	DECMINX	LOCENT	LOCACC	FNAME	LNAME	ST#	ROAD	ROAD2
105.0035	406	1181								T	SCANLON	$NULL	CAMPBELL DR	$NULL
105.0039	364	831881								B	DELLECHIAIE	$NULL	CAMPBELL DR	$NULL
105.0111	177	732								$NULL	STATE OF NH LIQUOR STORE	$NULL	RTE 95 NORTH	$NULL
105.0130	1424	95-77								A	CORMIER	$NULL	$NULL	$NULL
105.0151	1236	9751								$NULL	DINERO DEVEL	$NULL	$NULL	$NULL
105.0177	370	$NULL	76	425730	705124	7051.372034	4257.508911	1	1	$NULL	NH STATE LIQUOR STORE	$NULL	RTE 95	$NULL
105.0228	1808	1808-7								$NULL	BLEY REATY	$NULL	SOMERWOOD RD	SOMERWOOD
105.0239	1236	$NULL								$NULL	SUMMERWOOD	$NULL	TIMBERSWAMP RD	SUMMERWOOD
106.0048	141	279								M	BURNETT	$NULL	$NULL	$NULL
106.0166	1236	5								$NULL	GREAT WOODS POST & BEAM	$NULL	$NULL	$NULL
106.0255	1236	$NULL								DICK	ROBINSON	$NULL	BROWN RD	$NULL
106.0268	364	364-011002TW4								$NULL	GREEN & CO	$NULL	GOVERNORS RIDGE RD	GOVERNORS RIDGE
106.0287	364	364-020411RT2								$NULL	GREEN & CO	$NULL	BROWN RD	GOVERNORS RIDGE SUBDIV
106.0293	364	364-020821RT3								$NULL	GREEN & CO	$NULL	BROWN RD	GOVERNORS RIDGE SUBDIV
106.0330	1085	79-2004								$NULL	WASSON DEVELOPERS	$NULL	MARSTON RD	$NULL
106.0338	1085	122-2004								$NULL	KEVIN ODONNELL	$NULL	MARSTON RD	$NULL
106.0339	1	1-8393								$NULL	OPEN MEADOW HOMES	6	MARSTON RD	$NULL
106.0344	1236	$NULL								T.	MCGRATH	18	OLD STAGE RD	$NULL

Table E2. Water Well Data, Wells in NHGS Database but Not in GIS System, Within 1/4-Mile of Pond
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

WRB#	TOWN	MAP	PARCEL	DCOMP	USE	REASON	TYPE	TOTD	BDKD	CASING	YTM	YTD	YTQ	SWL	DMEAS	OB	HF	HF_BEFORE	GROUTED	NOTE
105.0035	HAMPTON	$NULL	LOT 2	29-JUN-1988	1	1	1	442	10	20	3	3	0.25			12	$NULL		$NULL	$NULL
105.0039	HAMPTON	$NULL	$NULL	30-AUG-1988	1	1	1	180	5	20	3		20	8	31-AUG-1988	4	$NULL		$NULL	$NULL
105.0111	HAMPTON	$NULL	$NULL	06-SEP-1995	4	1	1	400	41	51	3	0.5	15			1	$NULL		$NULL	$NULL
105.0130	HAMPTON	$NULL	$NULL	31-OCT-1995	1	1	1	300	20	41	3	0.5	4	10	01-NOV-1995	1-4	$NULL		$NULL	YL
105.0151	HAMPTON	$NULL	$NULL	01-MAR-1997	1	1	1	200	80	92	3	1	20			3	$NULL		$NULL	YL
105.0177	HAMPTON	$NULL	$NULL	10-SEP-1997	1	1	1	545	35	60	3	2	30	32	11-SEP-1997	2-4-2	$NULL		$NULL	$NULL
105.0228	HAMPTON	$NULL	LOT 42-43	07-JAN-2005	1	1	1	220	26	40	3	0.5	8	4	07-JAN-2005	14-24	$NULL		$NULL	$NULL
105.0239	HAMPTON	$NULL	LOT 7	19-JUL-2005	1	1	1	500	39	60	3	0.5	7			2	$NULL		$NULL	$NULL
106.0048	HAMPTON FALLS	$NULL	$NULL	01-JAN-1986	1	1	1	130	45	60	3	0.5	15	10		4	$NULL		$NULL	$NULL
106.0166	HAMPTON FALLS	$NULL	$NULL	23-JUN-1994	1	1	1	345	80	115	$NULL	0.5	8			4	$NULL		$NULL	YL
106.0255	HAMPTON FALLS	$NULL	$NULL	25-SEP-2000	1	1	1	220	35	49	3	1	10	10	04-OCT-2000	4	$NULL		$NULL	YL
106.0268	HAMPTON FALLS	$NULL	2	26-SEP-2001	1	1	1	140	37	51	3	0.5	20	20	26-SEP-2001	24	$NULL		$NULL	$NULL
106.0287	HAMPTON FALLS	$NULL	LOT 8	10-APR-2002	1	1	1	155	30	51	3	0.5	20	4	10-APR-2002	24	$NULL		$NULL	$NULL
106.0293	HAMPTON FALLS	$NULL	SUBLOT 6	06-AUG-2002	1	1	1	420	29	45	3	0.5	9	35	06-AUG-2002	12	$NULL		$NULL	$NULL
106.0330	HAMPTON FALLS	$NULL	3	02-AUG-2004	1	1	1	460	4	40	3	0.5	30			4	$NULL		$NULL	YL
106.0338	HAMPTON FALLS	$NULL	14	14-OCT-2004	1	1	1	200	70	75	3	0.5	30	20	15-OCT-2004	4	$NULL		$NULL	$NULL
106.0339	HAMPTON FALLS	$NULL	LOT 16	29-OCT-2004	1	1	1	180	15	41	3	1	25	5	02-NOV-2004	3	$NULL		$NULL	$NULL
106.0344	HAMPTON FALLS	$NULL	$NULL	12-MAY-2005	1	1	1	500	14	28	3	1	6			12	$NULL		$NULL	YL

Table E3. Data for Community/Public Water Wells
Input to Feasibility Study
Replacement or Removal of the Taylor River Dam
Hampton and Hampton Falls, New Hampshire

PWS ID	MASTER ID	SYSTEM NAME	ADDRESS	TOWN	SYSTEM ACTIVE	SOURCE ACTIVE	SYSTEM TYPE	SOURCE TYPE	WELL TYPE	RECORD SOURCE WATER TYPE	POPULATION SERVED
1056030-001	52988	EMPLOYEE BENEFIT PLAN ADMN	263 DRAKESIDE RD	HAMPTON	I	A	P	G	BRW	SG	100
1053010-001	14912	FOUR SEASONS MOBILE HOME PARK	120 MARY BATCHELDER RD	HAMPTON	A	I	C	G	BRW	SG	55
1053010-002	14912	FOUR SEASONS MOBILE HOME PARK	120 MARY BATCHELDER RD	HAMPTON	A	A	C	G	BRW	SG	55
1053020-001	53818	HEMLOCK HAVEN	HAVEN RD	HAMPTON	A	A	C	G	BRW	SG	207
1053020-003	53818	HEMLOCK HAVEN	HAVEN RD	HAMPTON	A	A	C	G	BRW	SG	207
1056040-001	52989	STATE LIQUOR STORE #73	INTERSTATE 95 SOUTH, PO BOX 1993	HAMPTON	I	A	P	G	BRW	SG	20
1053030-001	52992	TAYLOR RIVER ESTATES	TOWLE FARM RD	HAMPTON	A	A	C	G	BRW	SG	90
1053030-002	52992	TAYLOR RIVER ESTATES	TOWLE FARM RD	HAMPTON	A	A	C	G	BRW	SG	90

Abbreviations:
- A = Active
- I = Inactive
- P = Non-transient, non-community system (e.g., schools, hospitals, businesses)
- C = Community system
- G = Groundwater source
- BRW = Bedrock well
- SG = Groundwater, non-purchased

Reference: NHDES "One Stop Program GIS" website, March, 2007

USER'S GUIDE FOR WELL COMPLETION REPORT DATA SUMMARIES [rev. 12/08/2005]

Attribute	Explanation	Data Type, Codes and Definitions	Data Entry Conventions
LICENSE_NUMBER	Well driller's license number	Number (10)	driller's license no.
WELL#	Well # Assigned by Driller	Text (14)	sequence no.
WRB#	Water Resources Board I. D. number	Text (10)	[3-digit numeric town code]-[4-digit sequence no.] town code must include leading zeros
ELEV	Elevation	Number (5)	in feet above sea level
LATITUDE	Latitude	Number (8,2)	6 digit number for degrees, minutes, and seconds with leading zeros included (Datum:NAD27)
LONGITUDE	Longitude	Number (8,2)	6 digit number for degrees, minutes, and seconds with leading zeros included (Datum:NAD27)
LOCENT	Entity responsible for determining location	Number (5) 1 = NHDES staff 2 = USGS 3 = EPA 4 = Subcontractor 5 = Water well contractor	
LOCACC	Estimate of the relative Accuracy of coordinate values	Number (5) 1 =location self-reported by the facility or well owner, plotted on a 7.5-minute quadrangle, and hand-scaled	

Attribute	Explanation	Data Type, Codes and Definitions
LOCACC (continued)	Estimate of the relative Accuracy of coordinate values	2 = Location derived by remote desktop GIS methods 21 - Location derived by remote desktop GIS methods, utilizing digital orthophotography, digital tax maps, etc. Polygons representing discrete parcels were navigated to on an individual basis and the well placement determined by the GIS technician utilizing the best available information 22 - Location derived by remote desktop GIS methods, well placement automated utilizing the polygon centroid of the parcel 3 = field-verified location, plotted on a 15-minute quadrangle, and digitized. 4 = field-verified location, plotted on 7.5-minute quadrangle, and digitized. 5 = location based on autonomous global positioning satellite readings. 51 - located while selective availability was still active (before May 02, 2000) 52 - located after selective availability was turned off (on or after May 02, 2000) 59 - unable to identify datum / system settings 6 = location based on differential global positioning satellite readings collected at a site offset from the wellhead. 61 - located while selective availability was still active (before May 02, 2000) 62 - located after selective availability was turned off (on or after May 02, 2000) 7 = location based on differential global positioning satellite readings collected at a site offset from the wellhead with a correction for the offset applied. 71 - located while selective availability was still active (before May 02, 2000) 72 - located after selective availability was turned off (on or after May 02, 2000) 8 = location based on differential global positioning satellite readings collected at the wellhead. 81 - located while selective availability was still active (before May 02, 2000) 82 - located after selective availability was turned off (on or after May 02, 2000) 9 = unknown.

Attribute	Explanation	Data Type, Codes and Definitions	Data Entry Conventions
FNAME	First name of well owner	Text (15)	first initial of homeowner
LNAME	Well Owner, etc.	Text (26)	last name for individuals; complete name for contractors or companies (consult "dictionary" for accepted abbreviations)
ST_NUMBER	Street Number	Text (4)	street number where well is located
ROAD	Address of well location	Text (40)	street name or reference point (consult "dictionary" for accepted abbreviations)
ROAD2	Address of well location	Text (40)	other street name if applicable
TOWN	Town in which well is located	Text (45)	complete name of town (no abbreviations allowed)
MAP	Map page number as recorded on the town's tax map	Text (10)	varies according to the coding system in use by a particular town; prefix BLK- indicates block #
PARCEL	Parcel identifier as recorded the town's tax map	Text (12)	varies according to the coding system in use by a particular town
DCOMP	Date well was completed	Date	8-digit format dd-mon-yyyy with leading zeros included

Attribute	Explanation	Data Type, Codes and Definitions	Data Entry Conventions
USE	Proposed use of well	Text (1) 0=other 1=domestic 2=small community water supply 3=municipal 4=commercial 5=industrial 6=agricultural 7=institutional 8=test/exploration 9=abandoned	
REASON	Reason for constructing well	Text (1) 0=other 1=new 2=replace existing 3=deepen existing 4=provide additional supply 5=monitoring (water level measurement or water quality sampling) 6=stratigraphic observation only	
TYPE	Type of well	Text (1) 0=other 1=drilled in bedrock 2=drilled in gravel 3=dug 4=auger hole (any uncased hole) 5=driven point 6=wash well 7=undifferentiated	

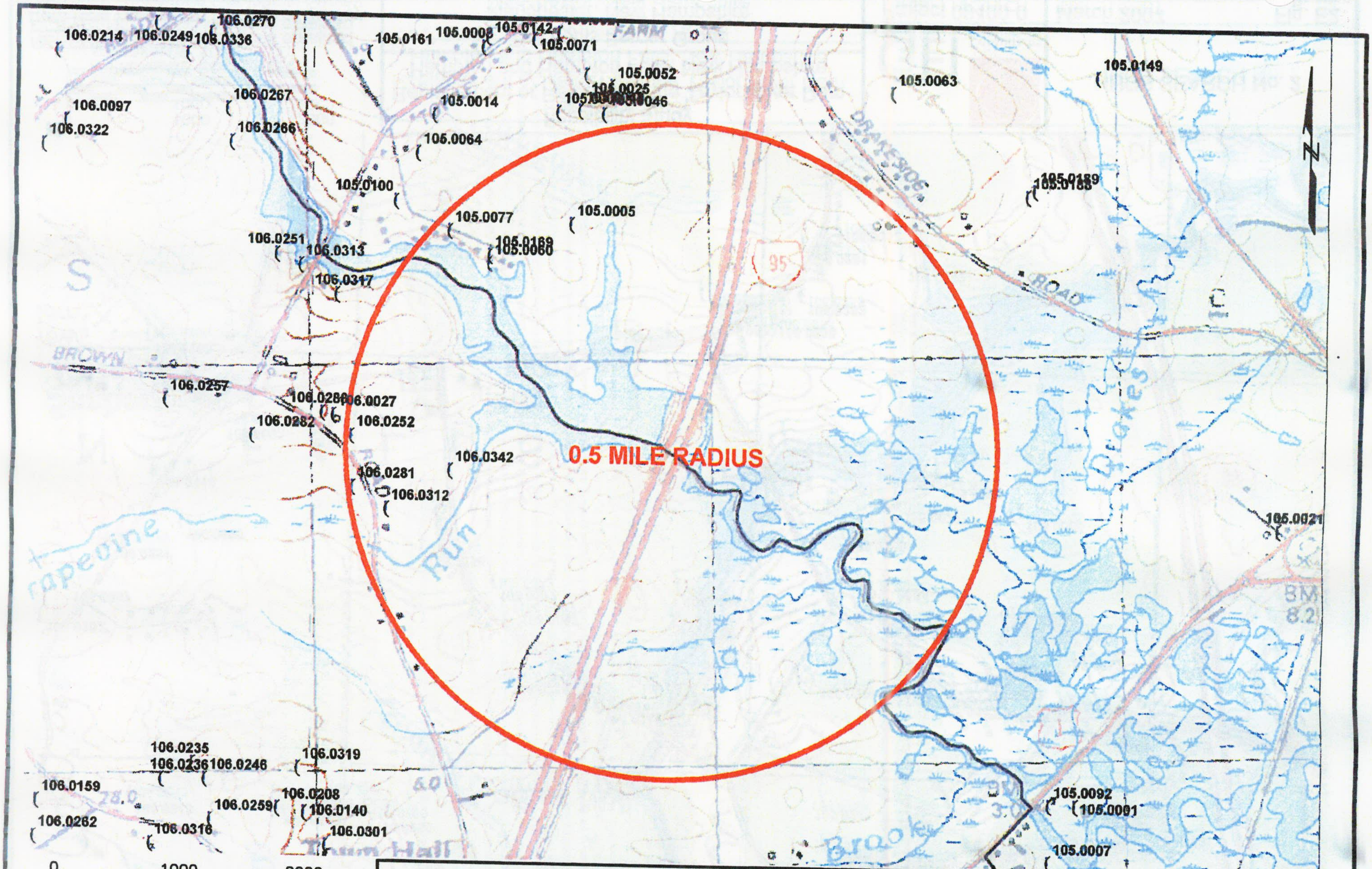
Attribute	Explanation	Data Type, Codes and Definitions	Data Entry Conventions
TOTD	Total depth of well	Number (6,2)	in feet below land surface datum
BDKD	Depth to bedrock	Number (6,2)	in feet below land surface datum
CASING	Total length of casing installed in well	Number (6,2)	in feet
YTM	Yield test method	Text (1) 1=bailed 2=pumped 3=compressed air	
YTD	Yield test duration	Number (8,2)	in hours
YTQ	Discharge	Number (8,2)	in gallons per minute
SWL	Static water level	Number (8,2) 0 = overflowing 1 = at ground level	in feet below land surface datum
DMEAS	Date static water level was measured	Date	8-digit format dd-mon-yyyy with leading zeros included
OB	Type of overburden material	Text (16) 0=exposed bedrock 1=sand 2=gravel 3=till 4=clay 5=mixed 6=other	Codes are entered layer by layer in the sequence reported in the **WELL LOG;** successive layers are separated by a hyphen (for example, 12-4 indicates a sand and gravel layer overlying a clay layer; mixed is used if 1 through 4 are recorded on the same line; if "6" is used, an explanation is included as a comment under the attribute **NOTE)**

Attribute	Explanation	Data Type, Codes and Definitions	Data Entry Conventions
HYDRO_FRACT	Hydrofractured	Text (1) Y="Yes" Null Value (-0-)="No" or not reported	
HF_YIELD_BEFORE	Yield before hydrofracturing	Number (8,2)	in gallons per minute
GROUTED	Grouted	Text (1) Y="Yes" Null Value (-0-)="No" or not reported	
NOTE	Special notes	Text (36) YL=yield log SN=screen information GP=gravel pack DD=drawdown measurements DL=detailed log HF=hydrofracture CM=comments NC=non conforming well location	

"CM:" is used to explain any attribute coded as "other" [ie., CM:USE(0)=fire protection]

THE FOLLOWING ADDITIONAL CONVENTIONS APPLY AS NOTED:

1) no periods are permitted to follow abbreviations within text fields, except in the case of NAME where a period is required after the first initial
2) any attribute coded as "other" must be explained by means of a comment under NOTE; however, the code for any attribute can be qualified using a comment expressed in the standard format CM:attribute(code)=explanation as illustrated above
3) the 2-character NOTE codes must always be given in the order listed above and separated by a single space whenever multiple codes are needed (ie. SN GP and not GP SN)



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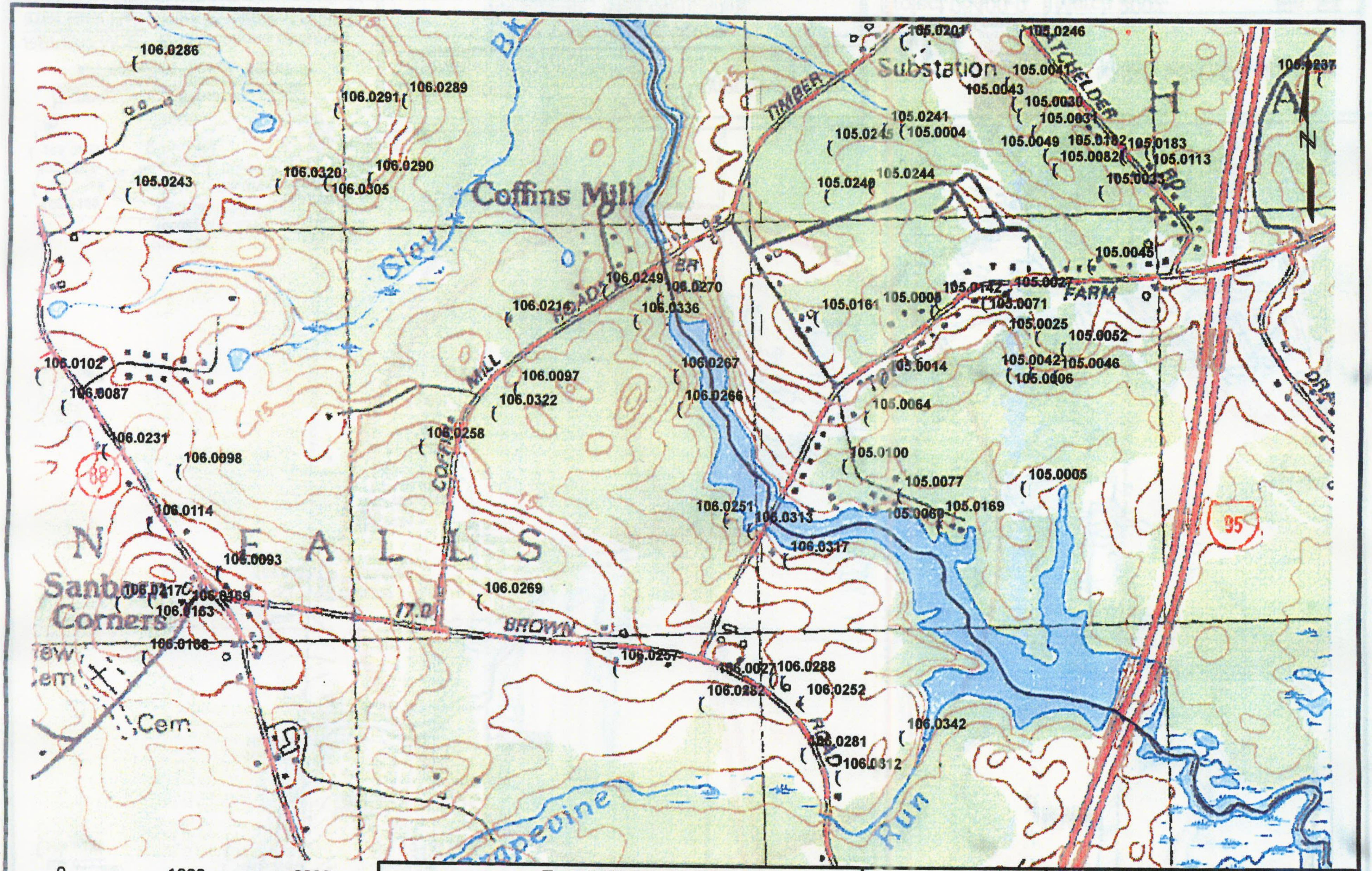
APPROXIMATE SCALE, FEET

REFERENCE: Well locations obtained from New Hampshire Geological Survey.

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	NHGS SEARCH No. 1
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. E1

064000-03 djm 3/20/07



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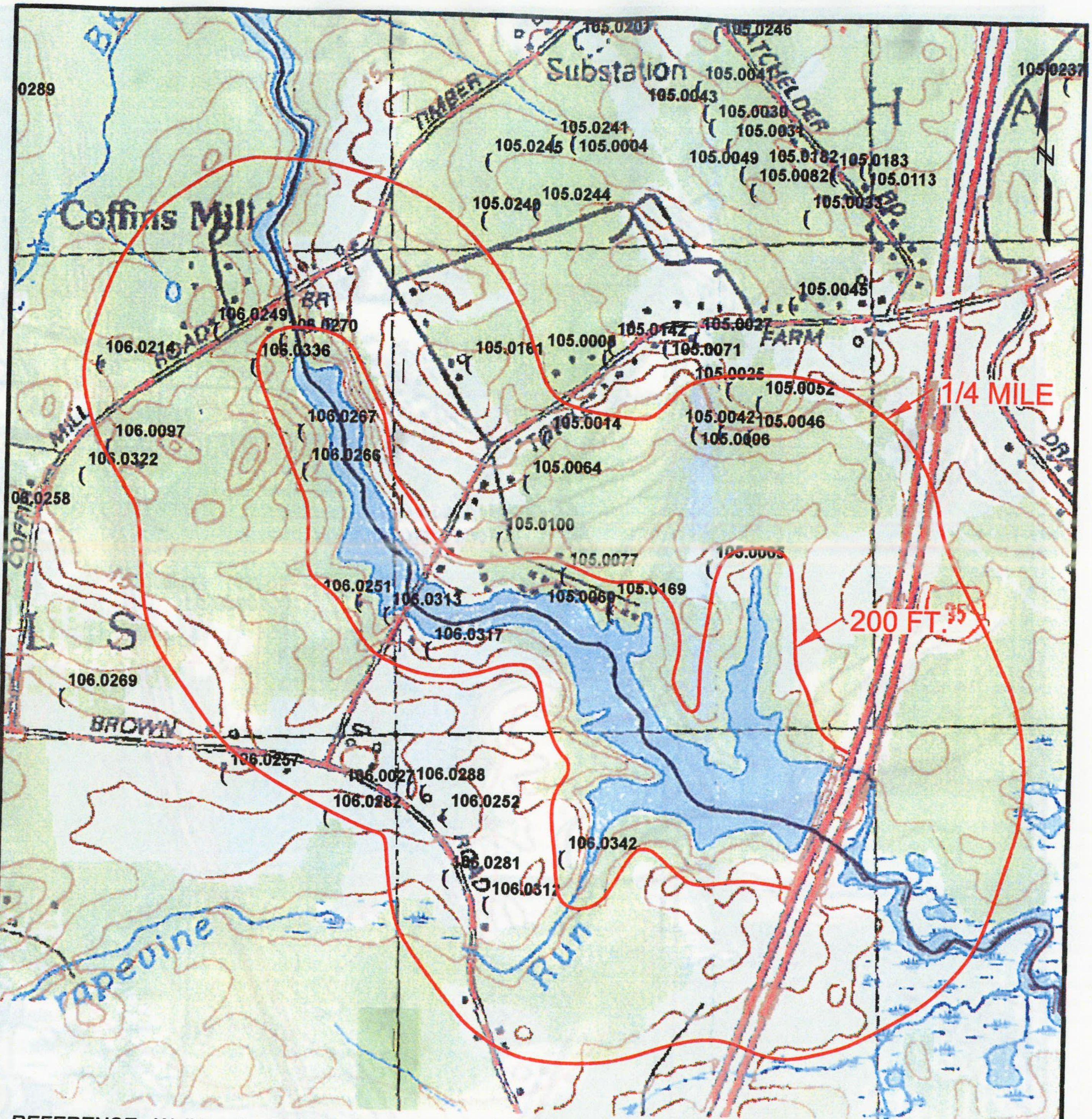
APPROXIMATE SCALE, FEET

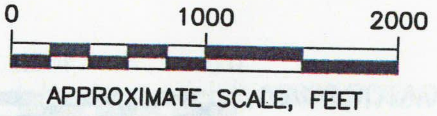
REFERENCE: Well locations obtained from New Hampshire Geological Survey.

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	NHGS SEARCH No. 2
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. E2

064000-0 3/20/07

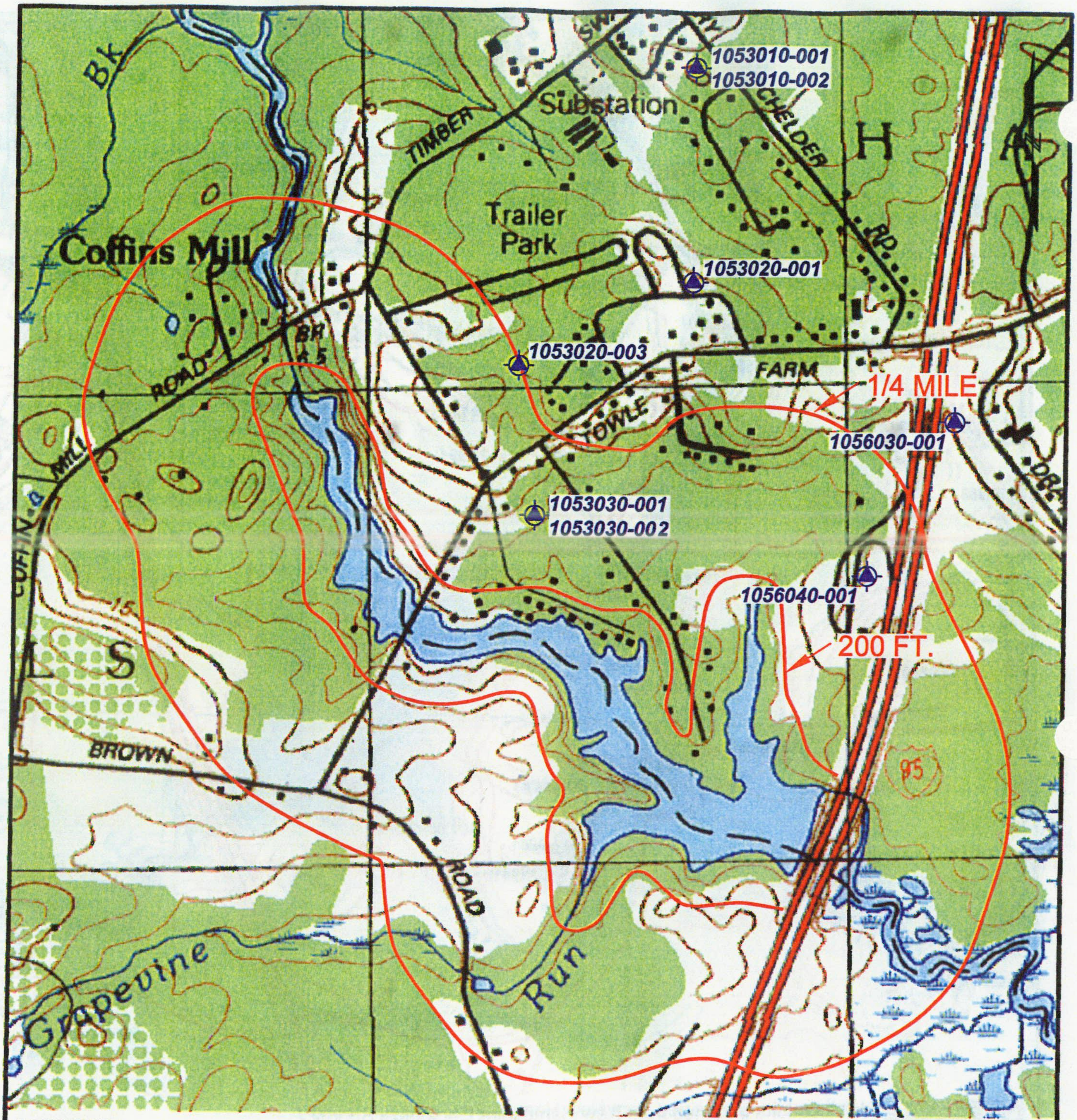


REFERENCE: Well locations obtained from New Hampshire Geological Survey.



Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	WATER WELLS IN GIS SYSTEM WITHIN 1/4 MILE OF POND
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 — Fig. E3

064000-03 djm/ptc 3/20/07



LEGEND:

COMMUNITY/PUBLIC WELL

NOTES:

1. USGS BASE MAP FROM MAPTECH, INC. "TERRAIN NAVIGATOR 2002."
2. WELL LOCATIONS FROM NHDES "One-Stop Program GIS" WEBSITE.

0 1000 2000

APPROXIMATE SCALE, FEET

Feasibility Study Replacement or Removal of the Taylor River Dam Hampton and Hampton Falls, New Hampshire	GEI Consultants	COMMUNITY/ PUBLIC WELL LOCATIONS
The Louis Berger Group Manchester, New Hampshire	Project 06400-0	March 2007 Fig. E4

064000-07 djm/ptc 3/20/07

Appendix D

"Sediment Management Plan", dated June 2009, by The Louis Berger Group, Inc.

Taylor River - Sediment Management Plan

The dam for Taylor River Pond consists of an earthen embankment, a primary spillway (with fishway) to the north of the embankment, and an emergency spillway in the center of the embankment to allow for additional outflows during peak storm events. The primary spillway is covered by a bridge for Route I-95. These structures have deteriorated and require mitigation, with the exception of the embankment.

Taylor River Pond contains an estimated 77,000 CY of sediment that has accumulated since the construction of the dam. Generally, the thickness of sediment that has accumulated in the Taylor River impoundment on top of the former marsh soils since dam construction ranges between <0.5 and 2 feet, with a mean of approximately 1.0 foot. The average sediment thickness was observed as 1 to 2 feet in the lower pond, 0.5 to 1 foot in the midsection of the pond, and 1 to 2 feet in the upper pond (Figure 1). The deposited sediment is fine-grained and organic-rich as a result of the widespread submerged aquatic vegetation in the pond.

The former tidal creek channel is submerged but still distinguishable on pond bathymetry mapping. The channel appears to be fairly narrow and defined based on field investigations. The channel has accumulated sediment at varying rates. More surveying would be needed prior to excavation to determine the width and depth of the channel in greater detail, as well as the amount of sediment within it.

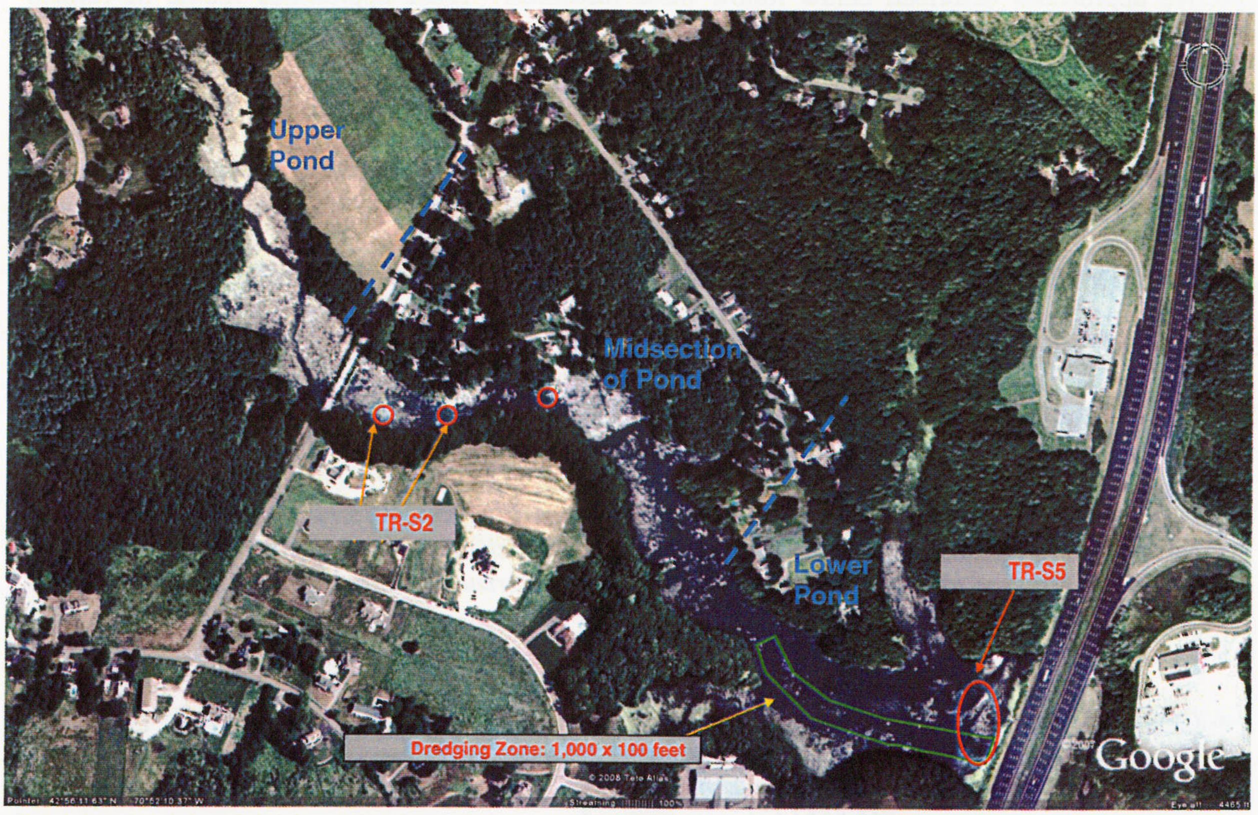


Figure 1: Taylor River Pond. The dredging zone proposed by NHDES is marked in green. The two stations (TR-S2 and TR-S5) mark the locations were sediment samples were collected along transects. In the upper and midsections of the pond, the distribution of the aquatic vegetation in the pond marks the location of the submerged former creek channel.

The former tidal marsh plain is fairly uniform in elevation. At low-flow conditions, and with the wooden stoplogs installed at the primary spillway for the pond, the water depth in the pond is between approximately 3 and 3.5 feet in the lower and mid-pond sections, and between 2 and 3 feet in the upper pond.

The sediments in the pond contain pesticides, as discussed in Section 3.3 of the Feasibility Study. All sediment chemistry investigations were coordinated and approved by NHDES. Based on the findings of the sediment analyses, NHDES concluded that the downstream portions of the Taylor River Pond are impaired for aquatic life and wildlife uses. The sediments do not impair human health, however.

Sediment management measures are required for both Alternative B (Replacement of spillways, fishway, and I-95 bridge) and Alternative C (Spillway removal and bridge replacement). The key measures consist of the following: (1) Excavation of a limited quantity of contaminated sediment (for both alternatives), and (2) Stabilization of exposed marsh plain areas for Alternative C. This sediment management plan is a first-order plan developed for the purpose of developing a preferred alternative.

1.0 EXCAVATION OF CONTAMINATED SEDIMENT

The NHDES decided on measures for addressing the contaminated sediments for both alternatives. The respective approaches described below follow these measures. These approaches should be refined further once a preferred alternative has been selected.

1.1 Alternative A: No Action

The sediment would remain in the Taylor River Pond under this alternative. Similarly, the risk of sediment being mobilized and transported to the downstream estuary remains unchanged.

1.2 Alternative B: Replacement of Spillways, Fishway, and I-95 Bridge

1.2.1 Determination by NHDES (May 19, 2008)

NHDES offered the following two options for this alternative:

- *Option A: "Design and install sediment control so that sediment will not be released downstream during the proposed project. An engineered design needs to meet performance criteria and will be a condition of the NHDES Wetland Permit. This plan shall be reviewed and approved by the NHDES Watershed Management Bureau and Wetlands Bureau prior to construction."*

OR

- *Option B: "Excavate and remove sediment in the impoundment in an area from the furthest point of the impoundment (closest to the dam) moving upstream to Transect TR-S2 (as identified on the approved sampling plan dated November 29, 2006, and as seen below). Based on the following parameters, a minimum of [5,555] CY is to removed :*
    - *i. 1,000 feet along the channel, starting from the lowest portion of the impoundment near the dam and moving upstream,*
    - *ii. 100 feet wide (channel width), and*
    - *iii. 1 ½ feet depth; and,*

Prepare and implement a plan to manage the excavated material which meets the S-1 soil standards (or the soil remediation standards in Table 600-2 in Env-Or 600) either within the right of way controlled by NHDOT or for disposal at an approved landfill. This plan should specify the frequency and parameters for confirmation sampling. This plan should be submitted to the NHDES Hazardous Waste Remediation Bureau for review and approval."

1.2.2 Sediment Management

Alternative B will result in a wider opening underneath I-95 to allow for more water to pass during flood events. This greater volume of passing water will result in greater flow velocities within the Taylor River Pond. The velocity increase in most of the pond is small, thus not expected to result in an increase in erosion of sediment. Thus, Option B offered by NHDES for consideration (*i.e.,* excavation of 1,000 feet along the channel) is not recommended. However, it is anticipated that flow velocities will increase more noticeably in front of the new spillway that is significantly wider than the present spillways. The new spillway is built in an area of the pond that currently experiences very low flow velocities, allowing fine sediment particles to settle out of the water column. These sediments in the immediate area in front of the new spillway would likely erode during peak flow events. Therefore, a small area is recommended to be excavated as allowed under Option A offered by NHDES.

The extent of the zone with increased flow velocities was estimated based on HECRAS model results. These results show that the velocities 200 ft upstream of the new spillway dam (Alternative B) during a 100-year storm are very low (0.5 ft/sec) which would not be sufficient to erode the sediment in the pond. As the water is funneled toward the new spillway, velocities increase.

We recommend the removal of a trapezoidal-shaped apron with a length of 160 feet, and widths of 140 feet along the downgradient side and 60 feet along the upgradient side (Figure 2). This apron includes the 60-foot long and 70-foot wide area of construction for the proposed new spillway and fishway. The remaining 100 feet are excavated to prevent potential resuspension of sediment, and to clear the area for the heavy equipment for the construction of the new spillway.

Key steps for the excavation of the material are expected to be as follows:

- **Preparation of an erosion and sedimentation plan for the construction operations.** This is the responsibility of the Contractor, to be specified in bid documents.

- **Installation of temporary sediment trapping basin downstream of dam:** A sediment trapping basin would be built immediately downstream of the new spillway to be able to capture sediment that may be mobilized from the construction site for the I-95 bridge, and from the sediment excavation area in the pond.

- **Partial dewatering of pond:** The pond would be partially dewatered in order to protect the aquatic resources. The existing primary spillway would be temporarily kept intact.

- **Excavation:** The surface sediment would be excavated from the suggested trapezoidal zone (or another zone with redesigned dimensions) within the partially dewatered pond. Excavation would best be conducted in the dry, or at least in standing water, to avoid transport of the resuspended sediment into the downstream estuary. Dry conditions in the excavation area could be achieved with temporary berms placed into the channel and with portable cofferdams (*i.e.,* Aqua Barrier™ or equivalent), as appropriate. Aqua Barriers are modular water-filled cofferdams (Figure 3).

Track-mounted excavation equipment (excavators, trucks) would move on timber-matting or other types of sturdy matting to prevent sinking into the substrate (Figure 4). It may also include the use of a low ground pressure excavator and truck for transport from the excavation location to a laydown area. The excavator may use a longer arm attachment to increase the reach of the equipment to properly extend into the tidal channel and minimize the repositioning of timber mats.

- **Disposal:** The excavated sediment is fine-grained and contains a high percentage of water. There are two options for disposal (1) Approved offsite landfill; or (2) Upland disposal.

  - ***Approved landfill:*** Based on the available chemical results obtained in this study, the sediment from Taylor River Pond would be accepted by landfills in the area (although the sediment is not expected to be usable as cover material). The most suitable landfill would be selected after a preferred alternative has been chosen. Transportation to a landfill would require that the sediment is either first dewatered or stabilized. Dewatering could be done within a bermed dewatering basin or via mechanical devices. Dewatering in a bermed basin would be a slow process given the fine-grained nature of the sediment. An alternative or enhancement to dewatering is stabilization of the sediment by adding polymer, quicklime, or another material. Adding such an amendment to the sediment would reduce the construction time significantly, but would require mechanical mixing of the sediment in a laydown area prior to offsite transportation, which would typically entail the use of a pugmill or mixing system that permits controlled addition of the amendment(s). Contractors often prefer to conduct bench-scale tests of amendments in advance of full-scale operations, so as to establish appropriate mixing ratios and evaluate properties of the amended sediment product. Both, a dewatering area or a laydown area would need to be set up in a manner that would allow loading onto heavy trucks along the perimeter of the dewatering area. Ideally, trucks should have access from the highway which would reduce transportation costs.

    Estimated transportation and disposal costs (per ton) for landfills in the greater vicinity of the Taylor River Pond are presented in Table 1. Final costs will depend on access to the site, nature of the material, volume, and potential use of the material at the landfill. Quotes should be obtained from the potentially suitable landfills.

Table 1: Estimated disposal costs for excavated sediment at landfills in the area

	Round Trip (miles)	Transportation and Disposal (per ton; estimate)
Bethlehem, NH	274	$ 55
Worcester, MA	165	$ 30
Haverhill, MA	46	$ 25
Rochester, NH	60	$ 70

  - ***Disposal at an upland site:*** The sediment could be disposed of at a suitable upland location owned by NHDOT (or another State agency), with appropriate NHDES approvals. The excavated sediment in the pond would not be suitable for beneficial reuse due to its small grain size composition. The ownerships of the properties in the immediate vicinity of the dam are presented in Figure 5 and Table 2. The most suitable location is the area immediately to the north of the dam which is owned by the State of New Hampshire, although disposal could result in temporary odor (*e.g.*, hydrogen sulfide odor) issues for the surrounding community.

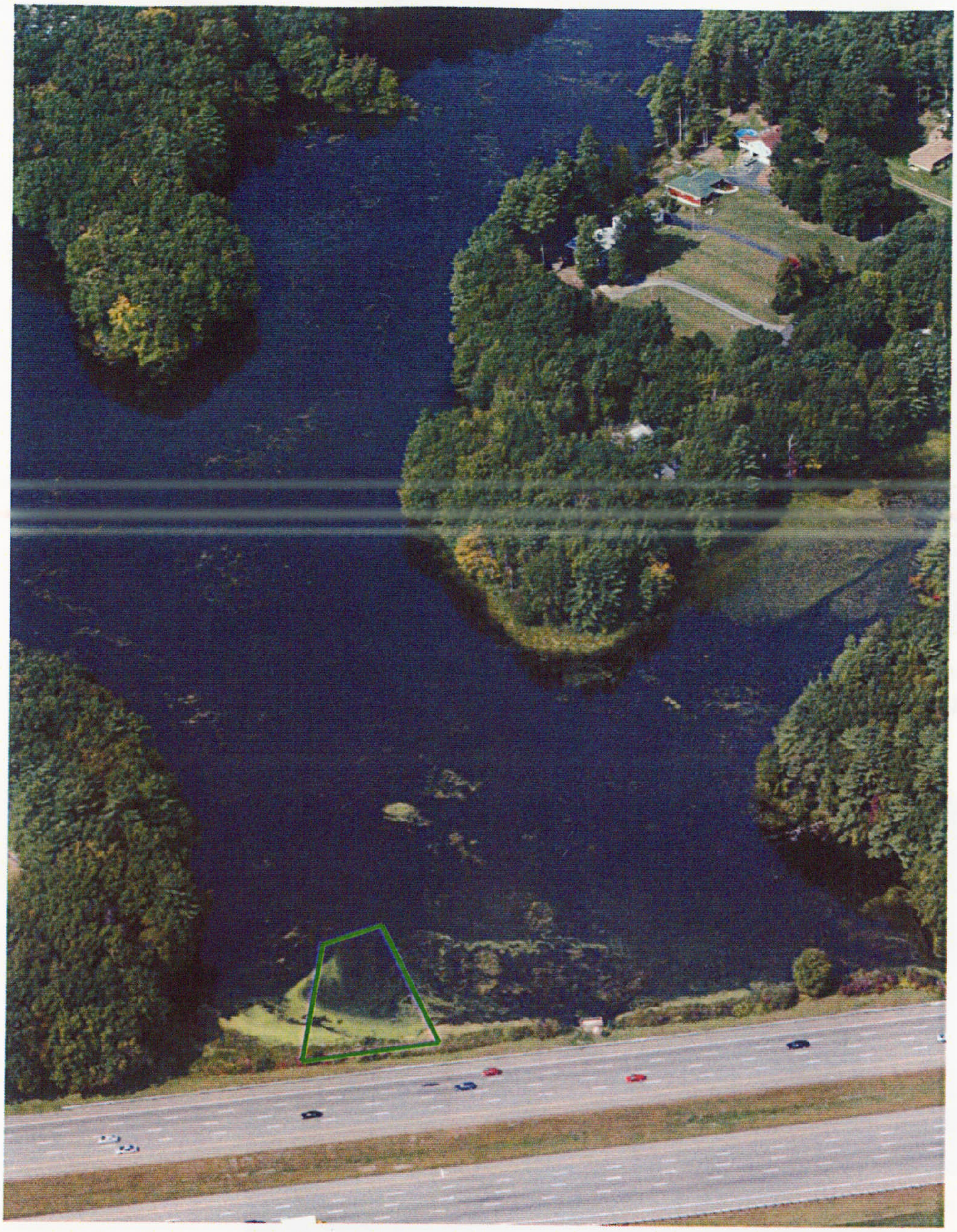


Figure 2: Taylor River Pond, with approximate area of excavation for Alternative B.

Figure 3: Example of portable cofferdams (Aqua Barrier™) used for work in a pond (Source: http://www.aquabarrier.com).

Figure 4: Example of timber matting with excavator and low ground pressure truck, operating in a marsh restoration project (Source: The Louis Berger Group, Inc.).

Figure 5: Ownership of properties near the dam.

Table 2: Ownership of property in the vicinity of the dam

	Map	Block	Property in Study Area	Property Owner	Owner Mailing Address	Town	State	Zip Code
A	171	1	I 95 Southbound	State of New Hampshire Liquor Commission	Storrs St	Concord	NH	03301
B	5	53-9 53-10	6 Swain Dr	Taylor River Farm	6 Swain Dr	Hampton Falls	NH	03844
C	5	57	Brown Rd E/S	NH State Housing Finance Authority	24 Constitution Dr	Bedford	NH	03102
D	9	2		Barbara Batchelder	290 Wadleigh Falls Rd Bldg 207	Newmarket	NH	03857
E to I	172	9	I 95 Northbound	State of New Hampshire	PO Box 483	Concord	NH	03302

Another option is the State-owned land to the east of the liquor store along the northbound lane of I-95. Other appropriate upland sites at a greater distance from the site may also be available. Some dewatering of the sediment may be needed if a selected site is located on the east side of Route I-95 as the sediment would be transported over public roads.

After a period of consolidation of the sediment, the site would be replanted. The soil is expected to be fertile, as it consists largely of topsoil from the surrounding watershed, including former agricultural fields. Further, the sediment contains a comparatively high concentration of organic matter.

- **Water treatment:** Dewatering of the sediment would occur by infiltration into the ground, surface water discharge, and evaporation. Depending on the nature of the underlying sediment at potential disposal sites in the area, infiltration of the dewatered liquid into the ground may be limited. Water draining from the dewatering basin or the laydown area via surface water runoff would be tested to determine if it requires treatment. At this time, we anticipate that suspended solids should be allowed to settle in a settling basin, but that the water quality would otherwise be adequate to allow for discharge to the estuary. If the water is too contaminated to be discharged to the estuary, it would require physical or chemical treatment prior to discharge. Treatment of the dewatered liquid would be incorporated into the permitting for the project.

Given the smaller volume of excavated sediment, on-site disposal of the sediment under Alternative B appears to be feasible, specifically considering that the land to the north of the embankment is owned by the State of New Hampshire.

1.2.3 Cost Estimates

Cost estimates were developed for the apron with the following dimensions: Length 160 feet; width at the base of 140 feet; width at the upstream end of 60 feet; excavation depth of 1.5 feet. These dimensions result in a total sediment volume of approximately 1,200 CY, including 35% overexcavation and excavation at laydown areas, etc. Landfill disposal is estimated to cost $270,000 to $350,000 (Table 3). Disposal on a nearby upland site is estimated to cost $200,000. These costs are first-order estimates that would need to be refined after selection of the preferred alternative.

Table 3: Cost estimate for disposal options

Activity	Unit Costs (per CY)	Alternative B (Replace Spillways, Replace Bridge) Volume (CY): 1,200			Alternative C (Remove Spillways, Replace Bridge) Volume (CY): 7,000		
		Disposal at Landfill		Disposal at Upland Site (within 1/2 mile)	Disposal at Landfill		Disposal at Upland Site (within 1/2 mile)
		Low Estimate	High Estimate		Low Estimate	High Estimate	
Engineering design services, permitting, testing, etc.		$60,000		$60,000	$100,000		$100,000
Excavation and dewatering of sediment *(incl. stop water, laydown area preparation, pumping, surveying, excavation, transportation to laydown area, preparation of disposal area (for upland disposal), mixing with polymer (for offsite disposal) or dewatering*	$75-125 (1)	$150,000		$120,000	$700,000		$525,000
Polymer	$10	$12,000			$70,000		
Transport and disposal of sediment	$35-100 *(2)*	$42,000	$120,000	$10,000	$245,000	$700,000	$30,000
Post-excavation confirmation sediment sampling		$10,000		$10,000	$30,000		$30,000
Total		**$274,000**	**$352,000**	**$200,000**	**$1,145,000**	**$1,600,000**	**$685,000**

(1) Alt. B: $125/CY for disposal at a landfill with required stabilization for longer distance trucking.
$100/CY for disposal nearby (upland). Stabilization with polymer for transportation is not required.
Alt. C: $100/CY for disposal at a landfill with required stabilization for longer distance trucking.
$75/CY for disposal nearby (upland). Stabilization with polymer for transportation is not required.

(2) $35 to $100/CY for trucking and disposal at a landfill (using a conversion factor of 1.4 from CY to tons, which is considered conservative. The factor could be lower due to the high organic matter content in the sediment.) Nearby upland disposal only requires costs for trucking.

1.3 Alternative C: Spillway Removal and I-95 Bridge Replacement

1.3.1 Determination by NHDES (March 19, 2008)

Based on the review of data developed during this project, the NHDES determined the following on March 19, 2008 regarding sediment management:

> *"Excavate and remove sediment in the impoundment in an area from the furthest point of the impoundment (closest to the dam) moving upstream to Transect TR-S2 .... Based on the following parameters, a minimum of [5,555] CY is to be removed:*
>
> *i. 1,000 feet along the channel, starting from the lowest portion of the impoundment and moving upstream,*
> *ii. 100 feet wide (channel width), and*
> *iii. 1 ½ feet depth; and,*
>
> *Provide a plan to manage the excavated material which meets the S-1 soil standards (or the soil remediation standards in Table 600-2 in Env-Or 600) either within the right of way controlled by NHDOT or for disposal at an approved landfill. This plan should specify the frequency and parameters for confirmation sampling. This plan should be submitted to the NHDES Hazardous Waste Remediation Bureau for review and approval.*

The dredging area determined by NHDES is shown on Figure 1. Alternatively, the area proposed by NHDES could be narrower, such as 50 feet instead of 100 feet, based on the dimensions observed in the estuary just downstream of the dam (Figure 6). At the same time, the length of the area proposed by NHDES (*i.e.*, 1,000 feet) only extends halfway to the sampling transect TR-S2 (Figure 1); thus the length could be doubled. Revising the shape in this manner is recommended as most of the sediment that is expected to be mobilized will come from the currently submerged tidal creek channel. Revising the shape of the excavated area would result in a commensurate net volume of excavated sediment.

Figure 6: Taylor River estuary, just downstream of the Taylor River dam. The width of the tidal creek channel and mudflat ranges from 25 to 40 feet.

1.3.2 Sediment Management

The determination by NHDES results in the removal of 5,555 cubic yards of sediment under this alternative. This actual excavated volume would likely be higher due to (a) the potentially higher sediment thickness in the channel, (b) overexcavation due to limitations of accuracy of excavation tools, and (c) excavation of sediment in the laydown area, access path to the channel, and other areas of equipment operation. For the analysis herein, we assumed an additional 25% of excavated material (*i.e.*, a total of 7,000 CY of sediment to be excavated).

Excavation should be conducted during low-flow conditions in Taylor River (*i.e.*, in the summer or early fall). A potential approach for removal of the sediment is described below; this approach requires further refinement and modification if Alternative C is chosen as the preferred alternative. Specifically, the refinement will include more detailed discussions with NHDES. Also, excavation contractors have somewhat different approaches and equipment for a project on this nature. Therefore, a more detailed management plan would need to be developed after Alternative C is chosen, as requested by NHDES (see above) that is appropriate for submission to the NHDES Hazardous Waste Remediation Bureau for review and approval.

The approach used for the removal of the sediment is generally similar to the approach used for Alternative B above, although sediment volumes would be considerably larger. Key steps consist of the following:

- **Preparation of an erosion and sedimentation plan for the construction operations.** This is the responsibility of the Contractor, to be specified in bid documents.

- **Installation of temporary sediment trapping basin downstream of dam:** A sediment trapping basin would be built immediately downstream of the new spillway to be able to capture sediment that may be mobilized from the construction site for the I-95 bridge, and the sediment excavation area in the pond. The trap would be designed in a manner that allows Taylor River water to pass from the pond area to the estuary without backing up into the pond.

- **Dewatering of pond:** The water from the pond would be drained, while keeping the both existing spillways intact. The outflow would be set up in a manner that prevents tidal waters from entering the pond, using a flap gate or similar device (see Giannico and Souder, 2005, for suggestions). The flap gate should be installed between the base of the primary spillway at an elevation of approximately 7.5 feet. The otherwise intact primary spillway would allow large stormwater flows that exceed the capacity of the flap gate to flow over the spillway, thus avoiding flooding of the construction zone in Taylor River Pond.

- **Excavation:** The surface sediment would be excavated from the required zone (1,000 x 100 x 1.5 feet; or another zone with redesigned dimensions) within the dewatered pond. The excavation would intend to replicate the dimensions of the channel that exists downstream of the dam (Figure 6). Excavation would best be conducted in the dry, or at least in standing water, to avoid transport of the resuspended sediment downstream estuary. This could be accomplished by bypassing the river around the area of excavation. Bypassing could be done in sections, using temporary berms placed into the channel and portable cofferdams (*i.e.*, Aqua Barrier™ or equivalent), as appropriate (Figure 3). River water could be pumped around the isolated excavation area as needed. Alternatively, a temporary channel could be dug parallel to the original channel, after the surface sediments (containing pesticides) were removed for appropriate disposal. Such a temporary channel could be much smaller than the original channel, as it would only be required to accommodate low summer flows.

As for Alternative B, track-mounted excavation equipment (excavators, trucks) would move on timber-matting or other types of sturdy matting to prevent sinking into the substrate (Figure 4). It may also include the use of a low ground pressure excavator and truck for transport from the excavation location to a laydown area. The excavator may use a longer arm attachment to increase the reach of the equipment to properly extend into the tidal channel and minimize the repositioning of timber mats.

- **Disposal:** Options for the disposal of sediment would be similar to options discussed under Alternative B, consisting of approved offsite landfill, or upland disposal.

- **Water treatment:** Water treatment approaches would also be similar to approaches under Alternative B, although the dewatering basin would be considerably larger.

1.3.3 Cost Estimate

Cost estimates for Alternative C are presented in Table 3. Costs are based on an excavated volume of 7,000 CY (i.e., 5,555 CY plus 25%). The option with landfill disposal is estimated to cost $1.1 to $1.6 million. The option with disposal on a nearby upland site is estimated to cost $680,000. As stated previously, these costs are first-order estimates that would need to be refined after selection of the preferred alternative. The cost estimate for the latter option presumes that no engineered capping or long-term monitoring of the disposal site would be required; such additional measures would increase sediment management costs.

2.0 STABILIZATION OF EXPOSED TIDAL MARSH *(for Alternative C)*

2.1 Stabilization Measures

Since the dam was constructed, on average one foot of sediment has been deposited on top of the pre-dam marsh surface. After dewatering the pond, the exposed sediments would consolidate as a result of dewatering and decomposition of roots from freshwater plants. Despite the remaining higher elevation of the tidal flat compared to pre-dam conditions, the intertidal marsh is expected to be largely inundated during high tide similar to pre-dam conditions for the following reasons. Using a rate of 2 mm/year for the average sea level rise for the northern New England coast (NOAA, 2008), the sea level has risen since the construction of the dam in 1950 by approximately 4 to 5 inches, compensating in a sense for part of the added sediment in Taylor River Pond. The high tidal elevation is on average around 5 feet (1.5 m) NGVD 29, ranging from 2.6 to 7.2 feet (0.8 to 2.2 m) during the survey from September to November 2006 (Figure 7). The elevations of the sediment surface of much of the existing pond range from 4 to 6 feet NGVD 29.

With the primary spillway at an elevation of 8.55 ft., the pond area is approximately 47.5 acres. Removal of the spillways exposes the former intertidal marsh within the confines of the Taylor River Pond. As stated in Section 3.13 of the Feasibility Report, as much as 21 acres of fringing inter-tidal salt marsh and mudflats could be restored with the spillway removed. Areas within the impoundment above the anticipated elevation of salt marsh habitat (approximately 5.0 feet NGVD29) would likely convert to a mosaic of forested wetland, shrub swamp, freshwater and brackish marsh.

Tidal flows would likely result in erosion of those parts of the former tidal creek channel that were not excavated. It is reasonable to assume that, over time, the pre-dam channel would largely be scoured out

naturally by tidal and freshwater flows. High freshwater flows could also erode some of the sediment on the initially barren marsh. Flow velocities and width of inundation for various storm frequencies at three locations in the dewatered Taylor River Pond area are presented in Table 4. These velocities pertain to ebb tidal conditions, which are higher than at flood tides, due to the freshwater runoff component. These velocities are average velocities across the inundated cross-section. The velocities in the central part of the inundated area (*i.e.*, within the tidal creek channel and along its edges are higher than on the outer parts of the inundated area.

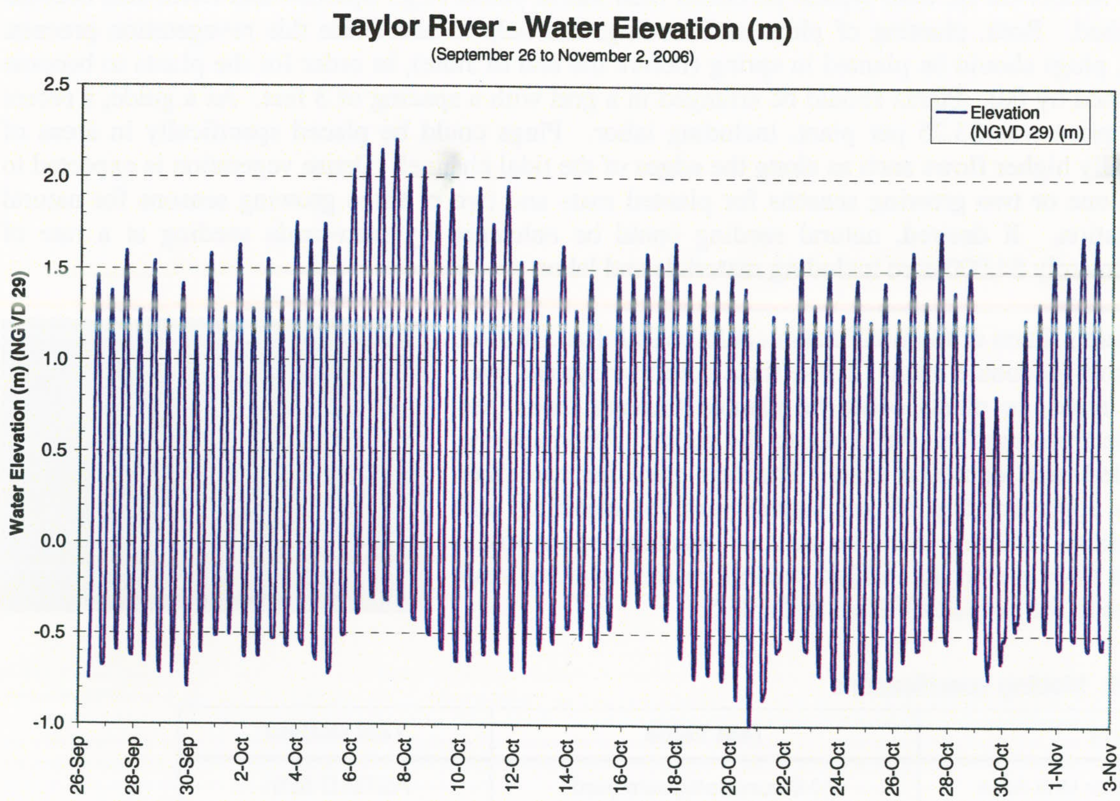


Figure 7: Tidal elevations in Taylor River, just downstream of the dam.

Table 4: Flow velocities in inundated area of Taylor River during various storms.

Storm Frequency	Location					
	500 ft downstream of Towle Farm Road		Midway between Towle Farm Rd and Route I-95		50 feet upstream of Route I-95	
	Width of Flow (feet)	Mean Velocity (f/s)	Width of Flow (feet)	Mean Velocity (f/s)	Width of Flow (feet)	Mean Velocity (f/s)
2-year	183	1.4	55	2.1	40	5.0
10-year	220	1.8	344	2.8	111	4.7
50-year	260	2.2	390	2.8	500	3.2
100-year	274	2.4	411	2.9	545	2.5

These velocities suggest that sediments would be resuspended and transported into the downstream estuary unless the marsh is stabilized, especially along the edges of the tidal creek. Complete tidal inundation would start immediately following the removal of the spillways. The post-dam fine-grained sediment lacks the matting from marsh vegetation that has not yet been reestablished. Recommendations for stabilization are as follows:

- **Seeding:** To a large extent, the exposed sediments would naturally revegetate from seed sources conveyed by tidal waters within the estuary. Initially, the dominant colonization would be by annuals such as *Salicornia* sp. until typical perennial tidal marsh plants (e.g., Spartina and Disticulus become established. Both, planting of plugs and seeding, can help to accelerate this revegetation process. Ideally, plugs should be planted in spring (before the end of June), in order for the plants to become established by fall. Plants should be arranged in a grid with a spacing of 3 feet. As a guide, a recent quoted price was $3.25 per plant, including labor. Plugs could be placed specifically in areas of potentially higher flows such as along the edges of the tidal channel. Dense vegetation is expected to require one or two growing seasons for planted mats and two or three growing seasons for natural revegetation. If desired, natural seeding could be enhanced by man-made seeding at a rate of approximately $4,000/acre including materials and labor.

- **Coir mats:** Parts of the tidal marsh could be stabilized further using coir (coconut) mats. These mats could be spread over seeded areas, or plants could be planted through them (see example from the firm RoLanka to the right). Alternatively, preseeded mats could be used. The unit price for coir fiber mats is approximately $5 per square yard for materials and installation. Matting shall be rolls of machine spun bristle coconut fiber woven into a high strength matrix. Matting shall conform to the properties listed in Table 5.

Table 5: Matting specifications

Property	Test Value	Test Method
Mass Per Unit Area	20.6 ounces/square yard	ASTM D 5261
Thickness	0.30 inch	ASTM D 1777
Tensile Strength	1348 x 626 pounds/foot	ASTM D 5035
Elongation	34 percent x 38 percent	ASTM D 5035

- **Natural Fiber Log (Bio-log):** Bio-logs are also made of biodegradable coir fiber. The logs are effective in reducing flow velocities along edges of banks and in trapping and retaining sediment (see photo on the right from a NOAA restoration project in the Chesapeake Bay[1]). At the same time, the needed moisture for plant growth is retained. Natural fiber logs can be molded to fit the bank line, and are anchored by wooden stakes or rock footers. Bio-logs can be planted or covered with plant seeds. The unit price for bio-logs is approximately $6 per linear foot for materials and installation.

[1] https://habitat.noaa.gov/restorationtechniques/public/shoreline_tab2.cfm

- **Flow control:** The spillways should not be removed until the tidal marsh vegetation has been established. This would allow for controlling the tidal flows entering and leaving the former pond area. Flow control should be exercised in a manner that (a) allows saline water to reach the tidal marsh to avoid that undesirable plant communities such as *Phragmites*, and (b) keeps flow velocities low to minimize erosion of sediment from the the still exposed marsh surfaces.

- **Predictive vegetation model:** Predictive vegetation modeling could be done to determine the anticipated plant communities that would become established over a 10-20 year time horizon. This model requires as input elevations, tidal prisms, salinity, and duration of inundation. The model can be a useful tool to guide planting efforts.

The specific approach to be chosen for stabilization of the high marsh sediments will need to be discussed further with NHDES. Ultimately, the preferred approach is a function of the following factors:

- Speed with which the marsh is to stabilize
- Risk tolerance for large storm events and their effects
- Extent of acceptable erosion and transport of sediment into the downstream estuary
- Approach used for excavation and final dimensions of excavated channel
- Available funding.

2.2 Cost Estimate for Restoration

Under Alternative C (Spillway removal and bridge replacement), reasonable first-order restoration costs are estimated to range from **$150,000** to **$250,000**. These costs would include the revegetation of marsh with some seeding/planting of indigenous marsh plants (aside from mostly natural revegetation), and some management to control *Phragmitis* and other nuisance species. Costs may be higher for reasons listed above.

Restoration is not needed for Alternative B (Replacement of spillways, fishway, and I-95 bridge).

3.0 VEGETATING UPLAND SEDIMENT DEPOSIT SITES *(for Alternative C)*

If sediments excavated from the pond are deposited on an upland location, they require some planting after sufficient time of dewatering. The sediment should be sufficiently fertile to support plant growth. Costs for vegetating and landscaping the disposal site depend in parts on the specific planting to be performed. Costs would be higher under Alternative C due to the larger size of the disposal area.

Taller trees would be expensive to install and have a high chance of failure; therefore, it is recommended to plant smaller trees. This applies specifically to the disposal mound which may still be partially unconsolidated, containing comparatively elevated water and organic matter contents. Generally, costs for installation of tree/shrub are approximately $40 per tree for materials and installation assuming trees are in no. 2 container and are 2 ft High and 0.25 to 0.375 inch caliper. Therefore, first-order cost estimates for landscaping and vegetating the upland disposal area are estimated to range from **$20,000 (Alternative B)** to **$100,000 (Alternative C).**

References

Giannico, G. and J.A. Souder, 2005, *Tide Gates in the Pacific Northwest - Operation, Types, and Environmental Effects*. Oregon Sea Grant, Corvallis, Oregon. ORESU-T-05-001.

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July 6, 2009
Project 06400-0

Geotechnical
Environmental
Water Resources
Ecological

Ms. Judith E. Houston, P.E.
Principal Environmental Engineer
The Louis Berger Group, Inc.
100 Elm Street, Suite 203
Manchester, NH 03101

Dear Ms. Houston:

Re: Information on Existing Water Wells in the Vicinity of Taylor River Pond
Taylor River Pond Dam
Hampton and Hampton Falls, New Hampshire

The purpose of this letter is to provide a summary of information we collected regarding water supply wells in the vicinity of the Taylor River Pond (Pond). On June 12, 2009, we submitted to Berger sections of text for the New Hampshire Department of Transportation (NHDOT) Feasibility Study for the replacement or removal of the Taylor River Pond Dam (Dam). Those sections of text included some of the information described below.

Scope of Work

We performed the following scope of work to help in evaluating the potential effects of removal of the Dam on nearby water supply wells:

- Collected and reviewed readily available information from the New Hampshire Department of Environmental Services (NHDES) on water wells in the project vicinity.
- Generated a list of properties within the study area from assessor's records in the towns of Hampton and Hampton Falls.
- Obtained information on the existing wells from the town offices and the well owners through a mailing that included a questionnaire.
- Retained Dr. Charles Fitts as an independent consultant.
- Contacted local well drillers to obtain information on water wells in the project vicinity.
- Prepared text to be incorporated into the Berger Feasibility Report.
- Prepared this summary letter.

Part of our original scope of work included obtaining samples from several existing water supply wells east of I-95, close to where Route 1 crosses the Taylor River, and testing those samples for salinity. At the request of NHDOT, we have not obtained those samples for testing.

Water Supply Well Data

To evaluate the potential effects on the wells, we obtained available information on the locations and depths of the wells near the Pond, which is created by the Dam, and whether the wells are screened in soil or bedrock. Per discussions with representatives of the towns of Hampton and Hampton Falls, there is no public water service in these towns, and the only private water company is Aquarion Water, which serves parts of Hampton. Aquarion's service does not extend west of I-95. Therefore, based on collected information, all water supplies in areas potentially affected by the project are provided by private household wells and community water supply wells.

Since 1984, the State has required submittal of installation data for new water wells, and the NHDES maintains a database of this installation data. In general, the State does not have information on wells installed before 1984, except for wells that are used as public water supply or community wells. Some of the installation data in the State's database has been incorporated into the NHDES GIS system. We obtained updated information from the NHDES on water supply wells installed since 1984.

The GIS map provided in Appendix A (Figure A1) shows the private wells located within the study area, generally within ¼-mile of the Pond. Tables 1 and 2 show the data summary for wells that are listed in the NHGIS general database for Hampton and Hampton Falls, respectively, and appear to be within ¼-mile of the Pond. Some of the well location information is missing, so some of the wells included in these tables may be more than ¼ mile from the Pond. The NHDES description of the fields in the summary tables is included in Appendix B.

There are wells within ¼ mile of the Pond that are not listed in these tables, either because they were installed before 1984 or because the required well installation logs were not submitted to the State. To obtain additional information, we visited the Assessor's Office in both Hampton and Hampton Falls to obtain tax maps and generate a list of properties from assessor's records. Property records were also available online for the town of Hampton through the Vision Appraisal website. Table 3 lists properties in Hampton and Hampton Falls that are located within our study area.

We prepared a questionnaire to property owners within the study area, including those residents serviced by community wells, to request water supply well information, including the location and depth of the well, the depth of the water below the ground surface, and any analytical test data on water samples from the well. Using the tax assessor's records for Hampton and Hampton Falls, we assembled a list of 248 property owners within ¼ mile of the Pond, 118 of which are property owners that obtain their water from community wells. The NHDOT sent out the questionnaires to all of the property owners under their letterhead on May 1, 2009. Of the 118 owners who rely on community wells, 24 responded, and of the 130 other owners, 59 responded. Copies of the returned questionnaires are in Appendix C.

Wells being used for public/community water supply are regulated by the State, regardless of the date of installation of the wells. Well locations and laboratory test data are available from the NHDES's "One Stop Program GIS" website. Figure A2 in Appendix A depicts the public water supply well locations from the website, and well data from the website are provided in Appendix D. Three active wells (2 wells serving Taylor River Estates and 1 serving the Hemlock Haven mobile home park) are located within ¼ mile of Taylor River Pond. We understand that a new well has recently been installed for Hemlock Haven, but is not yet in service.

The community wells and all of the water supply wells in Tables 1 and 2 are identified as bedrock wells. The well depths supplied by the property owners in the questionnaires are nearly all great enough that the wells would extend far into bedrock. We expect that wells in the vicinity of the Taylor River for which we do not have information are also typically drawing water from the bedrock and not the overburden. Based on collected data, we expect that the bedrock wells draw water from deep regional bedrock groundwater flow that trends southeast toward the ocean and trends locally toward the estuary. Typical household potable water supply wells in bedrock draw in water at a low rate, because the water contained within the well acts as storage, allowing for a slow, steady flow of water during pumping conditions. Consequently, we do not expect a large radius of influence with most of the bedrock wells.

We contacted the operators of the community wells to obtain information on typical water withdrawal rates for those wells, but that information was unavailable.

Although none of the wells are specifically indicated to be overburden wells, several of the well depths given in the responses to the questionnaire are small enough that these wells may obtain their water from the overburden rather than the bedrock. Also, one of the property owners indicated that when the level of the Taylor River Pond is low (such as during particularly dry periods or when water is released from the Pond), the quantity and quality of their well water decrease. This suggests the possibility of a direct connection between the Pond and the well.

A number of the well owners provided analytical data for samples taken from their wells. We obtained analytical data for the community wells from the GIS website. None of the data included measurements of salinity, but the concentrations of chloride in the samples were all below EPA drinking water standards and generally well below those standards. This indicates that salt water intrusion has not occurred to date at these well locations.

We also contacted seven local well drillers in the Towns of Barrington, Dunbarton, Henniker, Merrimack, Rollingsford, Sandown, and Stratham, New Hampshire to obtain general information on the wells in the area. None of the representatives we spoke to had experience directly within the study area. However, one driller indicated that well depths in the Seacoast area were often about 200 feet, that subsurface conditions encountered generally included clay overlying bedrock, and that yields were typically between 10 and 50 gallons per minute at this depth. Reportedly, no salt water has been encountered during drilling activities.

Potential Impacts on Water Supply Wells Following Removal of the Dam

One of the options currently being considered for this project is removal of the Dam. Because the Dam acts as a boundary between the fresh water of the Taylor River and seawater of the Atlantic Ocean, elimination of the Dam would permit the tidal seawater to travel up to approximately 0.6 mile upstream to the Towle Farm Road Bridge, and possibly as much as 1 mile upstream to the Rice Dam. A number of potable water supply wells are located near this stretch of the river, so we evaluated the potential for salt water intrusion to affect these wells following removal of the Dam.

If the Taylor River Pond Dam is removed, the width of the estuarine tidal area beyond the current dam location would be limited by the topographic contours within the Taylor River. The relatively small area covered by the new estuary limits the potential for the Taylor River to become a source of water flow into the underlying overburden and bedrock. In addition, the low hydraulic conductivity of existing glacial marine and fluvial sediments and glacial till would restrict flow of water vertically between the estuary and bedrock.

Based on topographic relief and the limited information we have regarding elevation of water in the bedrock wells near the Taylor River Pond, we believe that water levels in the bedrock are high enough to prevent the flow of estuary water to the bedrock wells, possibly except for the community wells and for wells located very close to the Taylor River Pond (perhaps within 200 feet).

For the overburden, we expect that in general, the overall flow within the system would be from the fresh water in the overburden into the estuary, thereby inhibiting saltwater intrusion into the overburden aquifer and minimizing the potential effects of lowering the Pond on overburden wells. However, anecdotal information from one of the well owners in the questionnaire response indicates that previous lowering of the Pond has negatively impacted their well, which is located within 30 feet of the Pond. The suggestion in the questionnaire response was that this has happened on multiple occasions. We do not know the depth of this well or whether it is an overburden well. We suspect that it is an overburden well, given that their well responded significantly to short-term changes in the Pond level.

The information we have regarding the wells in the study area indicates that there are few overburden wells. The GIS information indicates that the depth to bedrock is less than 50 feet in nearly the entire study area. Of the well depths listed in the GIS data and reported in the questionnaire responses, only 6 were less than 100 feet, suggesting that there are very few overburden wells. Also, based on the well depths reported in the questionnaire responses, nearly all of the wells close to the Pond are bedrock wells. However, many of the questionnaire responses did not include well depth.

Summary of Salt Water Intrusion Potential Following Dam Removal

Based on a review of published studies and existing project information, we do not anticipate that removal of the dam would affect the usability of potable water supply wells that draw water from bedrock. Although unlikely, it is possible that individual wells may be connected via bedrock fractures in a more direct way to the Taylor River than is currently known. This scenario is unlikely, because salt water intrusion rarely occurs this far inland in New England. In general, public/community water supply wells are more likely to be affected than household wells, due to the higher rate of pumping that could draw water from a greater distance.

Some of the information obtained from the property owners suggests that a few wells close to the Pond may draw water from the overburden. Wells drawing water from the overburden may be more susceptible to negative effects of lowering the Pond, either from salt-water intrusion or reduction in recharge from surface infiltration. However, as discussed above, we expect that there are very few of these wells.

Recommendations

To better evaluate potential limits of salt water intrusion, we recommend obtaining samples from 1 or 2 of the existing water supply wells east of I-95, close to where Route 1 crosses the Taylor River, and testing those samples for salinity. These wells are closer to the ocean than the Pond, are within an area that is continually flooded by salt water, and are in an area where surface water elevations are as low as or lower than at the Pond.

If these wells indicate elevated salinity, then it may be helpful to review bedrock well data elsewhere in the Seacoast area, focusing on wells near similar-scale estuaries with similar geologic

conditions that are comparable distances inland. These data would provide useful background regarding the potential for salt water contamination in similar settings.

It may also be helpful to further investigate wells that are very close to the Pond, particularly those that we suspect may be overburden wells, for example by:

- Resending the questionnaire to owners of the wells who did not respond to the questionnaire.
- Talking to owners who did respond to the questionnaire to clarify their experience with their wells.
- Opening some of the wells to measure the depth to groundwater.
- Removing the pump and measuring the depth of the well in some of the wells.

We appreciate the opportunity to work with you on this project. Please call me at 781-721-4084 if you have any questions.

Sincerely,

GEI CONSULTANTS, INC.

Richard F. Tobin

Richard F. Tobin, P.E.
Senior Project Manager

RFT/db

Attachments:

Table 1 – NHDES Summary of Water Supply Wells within Study Area, Hampton, NH
Table 2 – NHDES Summary of Water Supply Wells within Study Area, Hampton Falls, NH
Table 3 – Property Owners within Study Area in Hampton and Hampton Falls, NH

Appendix A – NHDES GIS Maps of Study Area
Appendix B – NHDES GIS User Guide
Appendix C – Residential Questionnaires
Appendix D – Community Well Data

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Geotechnical
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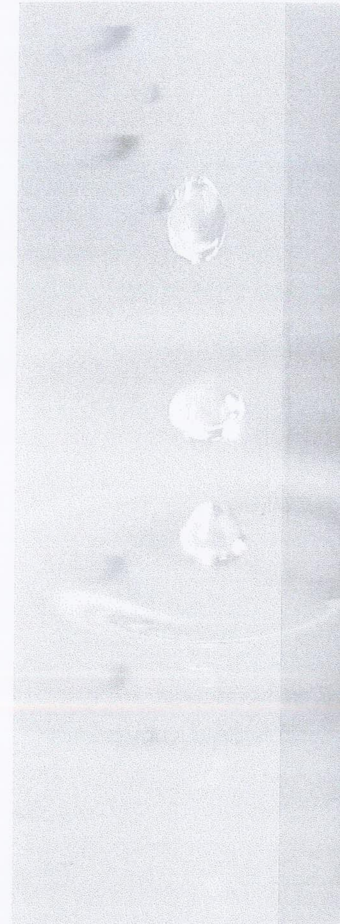
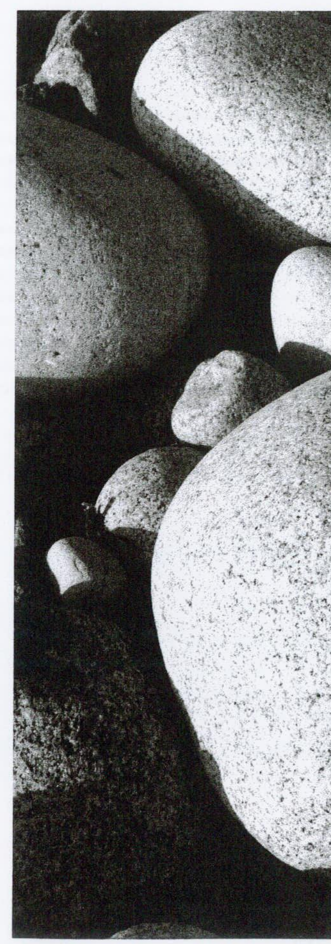


TABLES



Appendix F

**NHDOT memo from James T. Minichiello, Staff Appraiser,
to Harry C. Hadaway, Jr., Chief ROW Appraiser, entitled
"Appraisal Consulting Assignment, Real Property Value Loss Estimate....."
dated May 20, 2009.**

Rec'd 7/9/09

STATE OF NEW HAMPSHIRE
INTER-DEPARTMENT COMMUNICATION

DATE: May 20, 2009

FROM: James T. Minichiello
Staff Appraiser

SUBJECT: **Appraisal Consulting Assignment**
Real Property Value Loss Estimate in the Taylor River Estates Neighborhood, Hampton, NH and the River Willow Neighborhood, Hampton Falls, NH due to conversion of the Taylor River Pond impoundment to its original Tidal Estuary Located in Hampton and Hampton Falls, NH

TO: Harry C. Hadaway, Jr., Chief ROW Appraiser
THRU: Barry Moore, MAI, Appraisal Supervisor

Assignment Function:

This memo constitutes a summary report on a consulting assignment on the above referenced subject neighborhoods. The purpose of this study is to determine if there would be any value diminution incurred to the properties that currently have water frontage on the very shallow, 55 acre Taylor River Pond, which was formed when the Taylor River tidal estuary was dammed during the construction of I-95 in 1950. This pond is classified as being a Eutrophic body of water, or a "warm water" body of water. This classification means that the water has low clarity, and has a large amount of marine vegetation being mostly algae and being weed choked during the warm months. There is a proposal to remove this dam and fish ladder, releasing this impoundment/pond and restoring it to its original tidal marsh/estuary state. The Taylor River in the Before Situation provides limited recreational amenities due to its small size and shallow depth. There is small boating and warm water fishing plus the water view amenities.

In the After situation the pond will be removed leaving the original small tidal river or estuary, which is very shallow and narrow with contiguous mud flats. This river might provide some limited canoeing or kayaking at best. A good example of how this will look in the After Situation can be seen on the Tidal Marsh photograph Page 10 of this report.

Salt estuaries like the Taylor River are primarily located east of I-95 and Route 1 in the Seacoast Region. Very few are found west of I-95.

The intended recipients and those requesting the report are officials, employees, and agents of the New Hampshire Department of Transportation, Bureau of Right of Way.

Purpose of this Consulting Assignment :

The purpose of this study is to estimate the percentage loss in value to those properties in these pertinent neighborhoods, if any, due to the change in the waterfront amenity from a freshwater impoundment to that of a saltwater tidal estuary and salt marsh, in the Towns of Hampton and Hampton Falls.

Intended Use/User:

The intended use of this report is to assist the client, the New Hampshire Department of Transportation (NHDOT) in providing a reasonable and supportable market value loss, if any, for the pertinent properties as of May 19, 2009, the date of the exterior inspections. This consulting assignment report's only intended user is the NHDOT.

Definition of Market Value:

Market value is defined in the Uniform Appraisal Standards for Federal Land Acquisitions, Fifth Edition (Section A-9, Page 13) as:

"Market value is the amount in cash, or terms reasonably equivalent to cash, for which in all probability the property would have sold on the effective date of the appraisal, after a reasonable exposure time on the open competitive market, from a willing and reasonably knowledgeable seller to a reasonably knowledgeable buyer, with neither acting under any compulsion to buy or sell, giving due consideration to all available economic uses of the property at the time of the appraisal".

Scope of the Assignment:

My investigations and research included an on-site inspection of the subject neighborhoods on April 7, 2009 and May 20, 2009 with Barry Moore, MAI, Appraisal Supervisor during which time the subject's two primary affected neighborhoods, adjoining land uses and the pertinent waterfront amenities were noted and investigated. Also, at this time photographs were taken of the subject water body. Interviews were conducted with the Town assessor in Hampton. The most relevant sales data for residential waterfront and tidal estuary sales were investigated and analyzed as they pertained to the subject's existing impoundment waterfront in the Before Situation and the tidal marsh/tidal river in the After Situation. Due to the limited number of comparable sales with similar amenities in the subject neighborhoods, additional sales research was conducted throughout the Seacoast Region in order to estimate the average loss in value for each neighborhood. Sources other than Town sources included various real estate services such as MLS, and sales from the appraisal office files obtained and verified from previous assignments conducted by the appraiser, other staff appraisers and outside brokers.

Also, Deb Loiselle, River Restoration Coordinator, NHDES, Water Division-Dam Bureau, supplied additional pertinent neighborhood data relevant to the impoundments description. Bob Landry of the NHDOT provided the Louis Berger Group Report on the Taylor River Pond, which described the water quality and recreational aspects of the pond. Saltmarsh and tidal estuary properties are in greater demand than small residences with small-pond frontage according to Curt Touche, a Portsmouth broker who specializes in water front properties. He further stated that this is the case only with tidal estuary properties that have deep water or ocean access. The sales and information were compiled, analyzed and my value loss estimates summarized for the subject neighborhoods.

This report is a Real Property Appraisal Consulting report that is in compliance with Standards Rules 4 and 5 of the Uniform Standards of Professional Appraisal Practice (USPAP) (2008-2009 Edition). Please reference my Certification and General Assumptions and Limiting Conditions at the end of this report that forms the basis of this current valuation analysis.

Subject Neighborhood and Identification:

Hampton: This neighborhood (Taylor River Estates) is comprised of modest single-family residences that range in value from $195,000 to $295,000. This neighborhood is a condominium where the underlying fee simple interest in the land is owned in a condominium form of ownership. There is common access to the Taylor River Pond and the many of the residences have actual water frontage on the water. The topography of the shoreline is gentle and also has a southern exposure. Access to the water in this subdivision is good and many of the homes have docks on the waterfront.

Hampton Falls: This upscale development known as the River Willow Subdivision also has pond frontage, which is steeply sloping and has a northern exposure. Waterfront access is poor due to the sloping topography of the waterfront. This neighborhood has home values in the $700,000 to $800,000 range and it is an equestrian neighborhood having a large horse facility on its easterly section next to I-95. The focus of this neighborhood is on horses not the limited waterfront amenities. The shoreline has a hotwire fence for the horses since most of the shoreline is steeply sloping.

Study Methodology- Paired Set Analysis:

The amenities of water frontage, water frontage rights, water views and access are among the strongest value considerations in real estate acquisition. The type and quality of water frontage (lake, pond, ocean, tidal estuary ease of access to the water, etc.) are highly valued amenities that are a large component/factor influencing price levels. Even a specific subdivision that has locational commonality, the price difference between similar lots can be substantial if the waterfront amenity is different, all other factors being similar. These differences can be only obtained or extracted from the market by thorough study and using analytical tools such as Paired Sales or Set Analysis, which is further described as follows.

In order to isolate an item or factor of value, sales may be paired or matched to identify or isolate specific differences on market price. If two sales are closely comparable except in one respect, an analysis may indicate a reasonable market adjustment for the specific difference. The value difference that is being in this case is the difference between a property that has water frontage on a pond of limited recreational desirability due to its Eutrophic Class before the dam removal and a property that in the After Situation has tidal estuary frontage with its associated mud flats and marsh.

Application of this technique is complicated by the fact that the improved properties have differences in the time of sale (market conditions), size, location, and physical characteristics, etc. In order to get a meaningful pairing, the matching properties have to be closely comparable in all factors excepting the difference that is being isolated, which is in this case, the difference between low grade pond frontage and a tidal marsh/estuary. Adjustments also have to be made if necessary for changes in market conditions in order to obtain the most accurate value consideration extraction. The typical market units of comparison are usually the price per square foot of gross living area (GLA), for an improved property and the price per lot for land.

These were the units utilized for this analysis.

Comparable sales having water frontage on impoundments and sales on tidal estuaries or rivers were obtained in the Seacoast Region in order to get sufficient data for this extraction of the locational difference on the subject. Approximately 170 Seacoast Region, waterfront sales were researched and out of these 50 were similar to the subjects Before and After Situations. These 50 sales were utilized for this analysis in order to determine the price differences between pond and estuary properties on a negative percentage basis.+

These are the following matches:

Matched Sets Analysis

1. Dover: 2 samples, Match between Bellamy Reservoir and Barbadoes Pond to the Cocheco River. This set indicated a –39% and -49% difference between pristine ponds and a pristine freshwater river.

Mean difference is **–44%**

2. Durham: 9 samples, Matched between

Mill Pond, Lamprey River Pond to Beard's Creek, Wiley Creek and Bunker Creek. These matches are very comparable to the differences between and impoundments and tidal estuaries with no ocean access being very similar to the subject's before and after situations. This set indicated the following percentage differences.

-2%, -7%, -14%, -18%, -21.5%, -23%, -25%, -26%, -30%. Range is **–2% to –30%.**

Mean difference is **-18.5%.** The best match as far as similarity is the -21.5% set, which is close to the mean.

3. Portsmouth: 9 samples, in a high-end land residential subdivision matched between lots that had waterfront on Sagamore Creek and interior lots with no frontage. Waterfront access from the individual lots is poor due to the sloping, rocky shore- line and the tidal nature of Sagamore Creek. Some lots have a better shoreline topography being more conducive to dock construction and water access than others as indicated by the large difference in the price range in this subdivision. The Portsmouth location is also a factor in price levels in this Tucker Cove /Sagamore Creek neighborhood.

-7.7%, -14.6%, -22.4%, -29.3%, -36%, -54%, -62%, -70%, -80%. Range is **–7.7% to –80%.**

Mean difference is **–41.78%.** Ocean access and water view influence is apparent due to its proximity to the ocean, which could lead to greater percentage differences between waterfront and non-waterfront lots.

4. Hampton Falls: 2 samples, in rural, small land subdivision (Starvish Lane) between one lot on a small pond and two lots across the street located on wetlands. This subdivision is located in the subject community but is a lower priced development from River Willow not compared to the River Willow neighborhood..

-13.42%, -14.9%.

Mean difference is **–14.2%.**

5. Hampton (near subject): 1 sample, located on the Taylor River Pond on Towle Farm Road compared to a property located on Towle Farm Road off the river. The indicated difference is:

-10.7%

6. Hampton Falls: 2 samples, this match consists of comparing a property on the Taylor River to two properties that do not have any waterfrontage of any type.

-13%, -17.8% Indicated Mean is **–15.4%.**

7. Hampton Falls (Taylor River Estates) Subject Neighborhood: 12 matches located in the subject neighborhood comparing similar properties, some with waterfrontage on Taylor River Pond to properties without Taylor River Pond waterfrontage. This condominium development has common area land on the pond. The properties closest to the easterly end of this neighborhood are within sight distance of the southbound lane of I-95. There could possibly be some negative impact on values due to this highway's proximity due to traffic noise and visibility.

-7%, -10%, -10.7%, -12%, -12.5%, -14.7%, -16.4%, -18%, -21%, -25%, -29%, -31.8%

Range is –7% to –31.8%. Indicated Mean is **–17.3%,** Indicated Median is **-15.6%.**

8. Hampton Falls (River Willow Subdivision) Subject Neighborhood: 2 matches, one property located on the Taylor River Pond and 2 properties located away from the river. This $700,000 to $800,000 neighborhood can be defined as an equestrian neighborhood. The greatest

amenity in this subdivision is the focus on horses not the Taylor River water frontage. The common area is improved with stables riding rinks and trails, being located in the easterly portion of this development. The waterfrontage on this side of the Taylor River Pond is steeply sloping and it is fenced off with "hot wire" to protect the horses. The two matches are as follows:

-2.6%, -3.2% indicating a mean of –2.9%

<u>Conclusions of Value Diminution</u>

River Willow Neighborhood

This neighborhoods data is limited because this is a neighborhood of only several homes with the major amenity being the equestrian amenities such as the indoor facilities, riding rink, trails and stables. The above referenced sets in the subject neighborhood indicate a mean of

–2.9% for a difference between the waterfront property and the properties located away from the water. A reasonable percentage difference would be a **–5% loss in value** for the water front properties if the pond is drained and the water-frontage is transformed into a tidal estuary salt marsh.

Therefore, based upon the above-discussed analysis, an average **-5% Value Diminution** seems reasonable for those properties in the River Willow neighborhood due to loss of pond water frontage. The inferior quality of this neighborhoods steep shoreline and less emphasis being placed on the waterfront amenity warrants a smaller percentage loss in value.

River Willow Neighborhood, Hampton Falls; -5% Value Diminution

Taylor River Estates Neighborhood

Arranging and listing <u>all the above sets</u> indicated a mean of –23.44% and a median of -17.8%. Discarding the 9 lowest samples and 9 highest samples indicates a range of –12% to –29.3% with 21 samples. This refined sampling indicates a mean of –19.12% and a median of –17.8%. The Durham sampling, which closely represents the subject's Before and After Situations, indicates a mean of –18.5% and a median of –21.5%. These figures correlate very closely the Taylor River Estates mean of 17.3%, which is given the greatest weight being the subject neighborhood.

For this lower priced neighborhood, an average loss in value is estimated to be 10% to 20%. For those properties with direct frontage on the Taylor River Pond, this was estimated to be 20%. For those properties within the Taylor River Estates development with a shared common interest in the water amenity, an average loss in value of 10% is estimated to be reasonable.

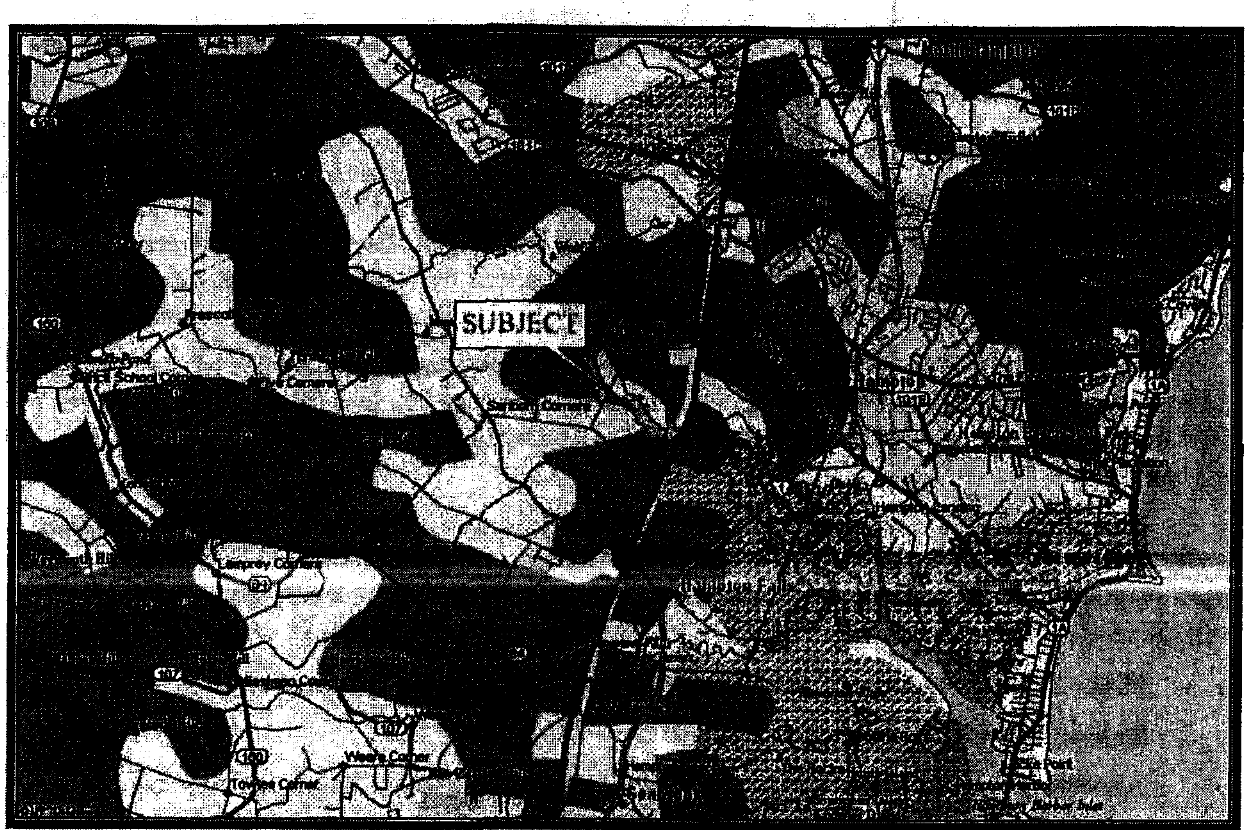
Taylor River Estates Neighborhood, Hampton; -20% Value Diminution
Direct Water-frontage Properties
-10% Value Diminution Common
Area Water Access Properties

James T. Minichiello

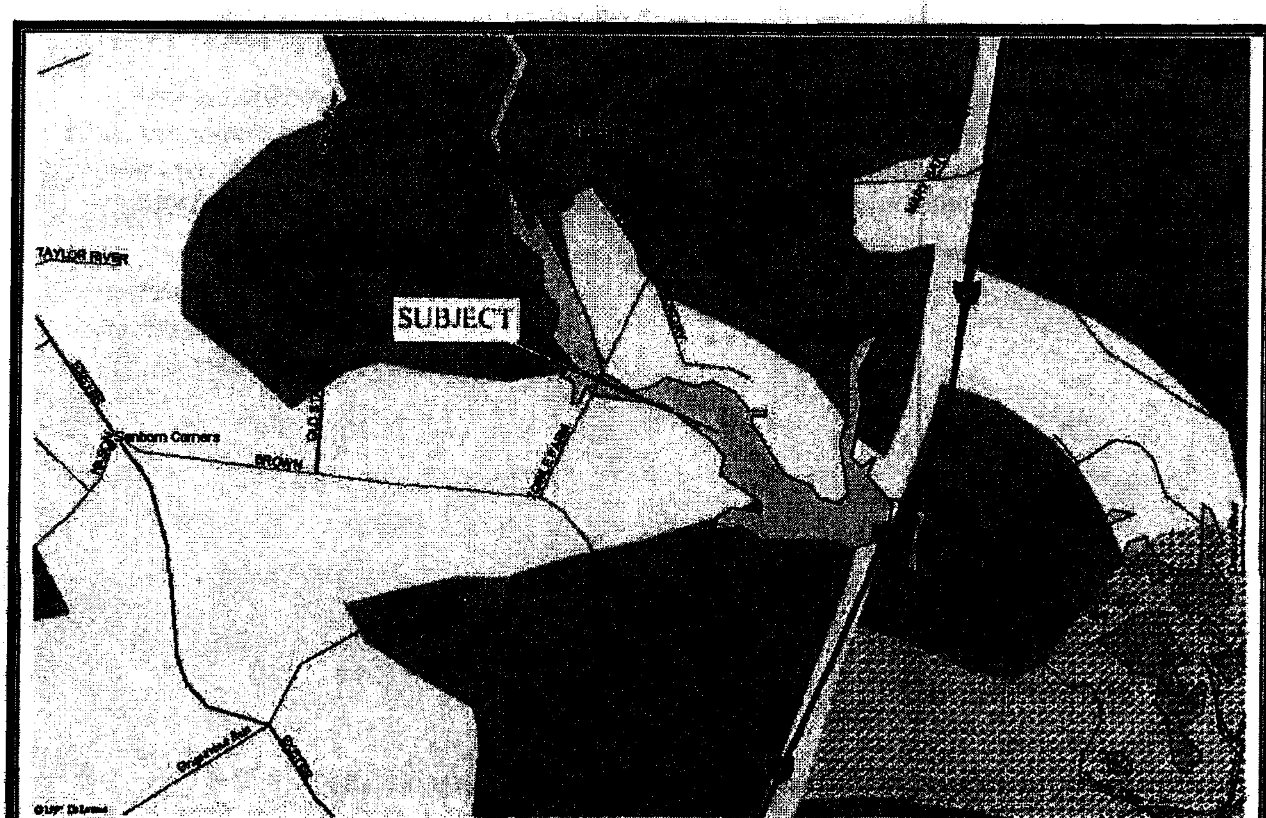
James T. Minichiello
Staff Appraiser

If you have any questions, please do not hesitate to contact me at #271-1630.

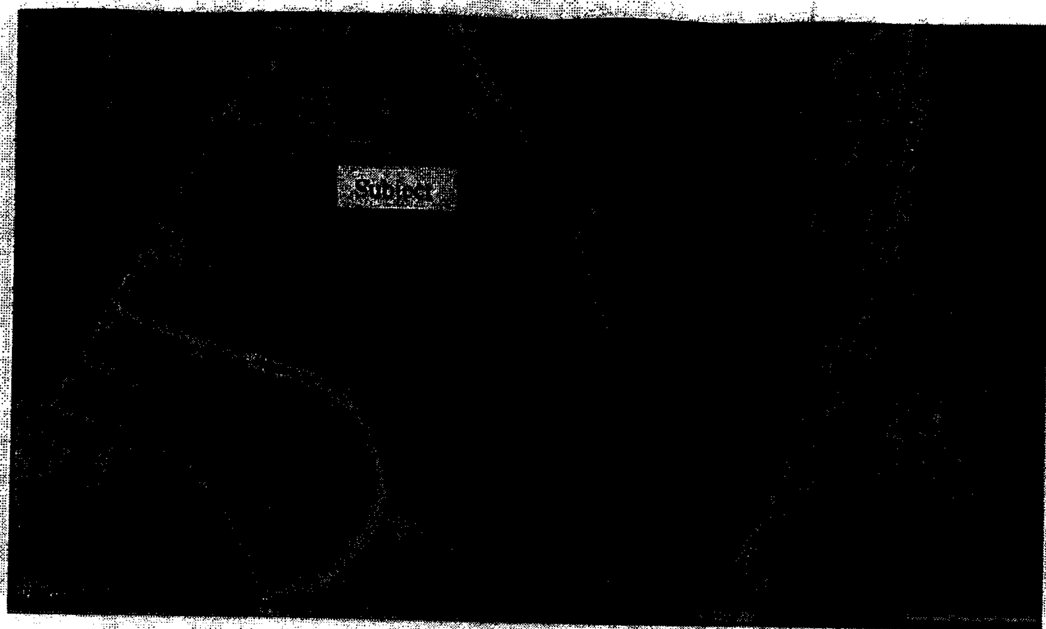
Subject Location Map



Subject Neighborhood Map



Subject Aerial Map

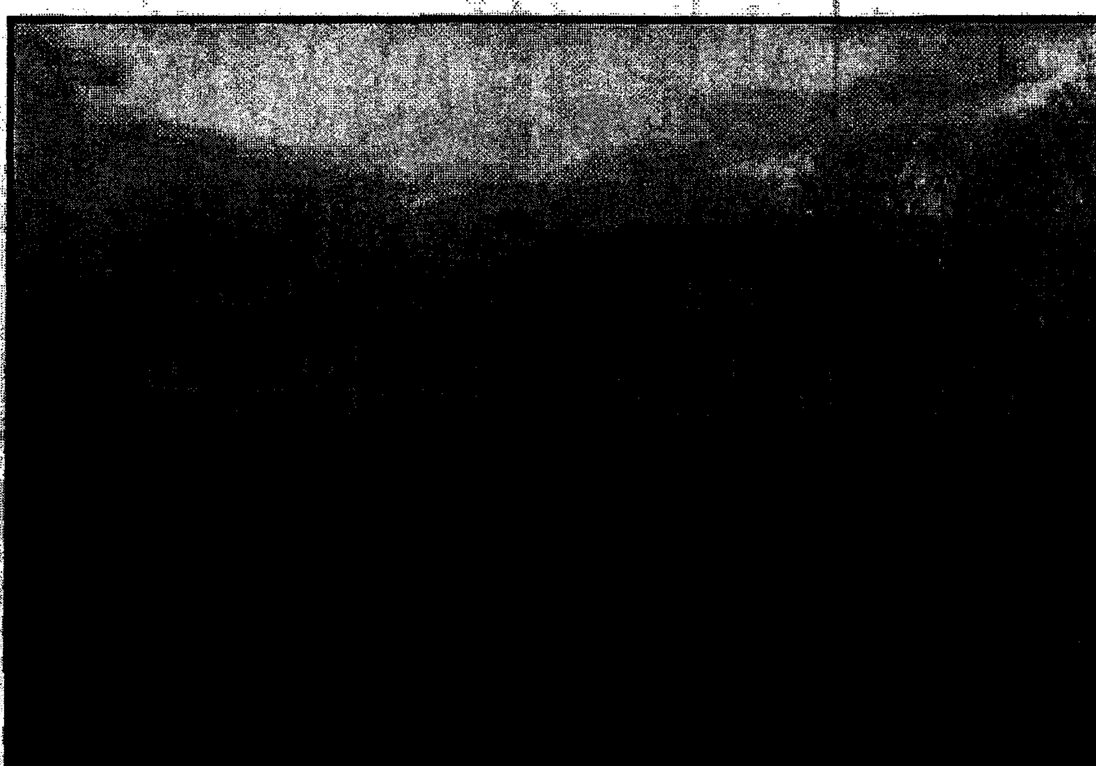


Subject Topographical Map

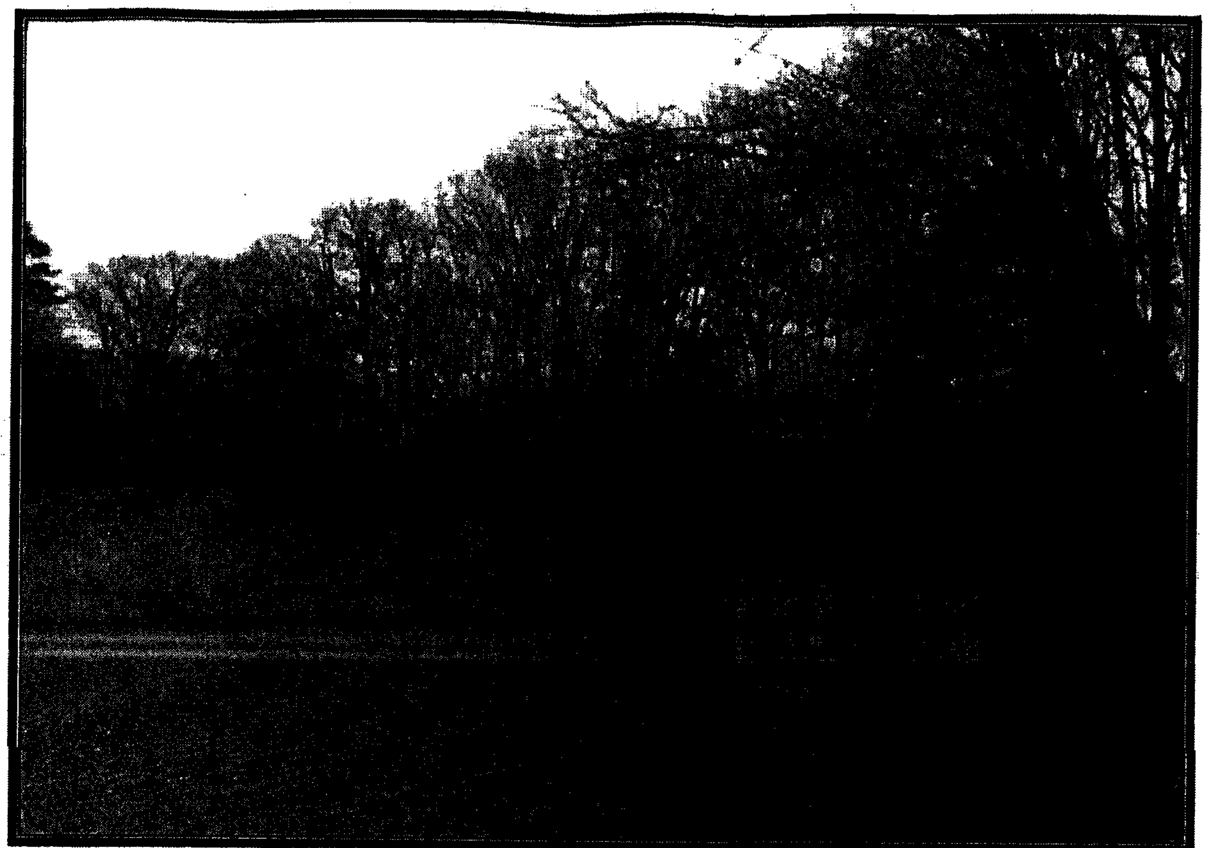
Subject Photographs

All Photographs taken by James T. Minichiello on 4/07/09.

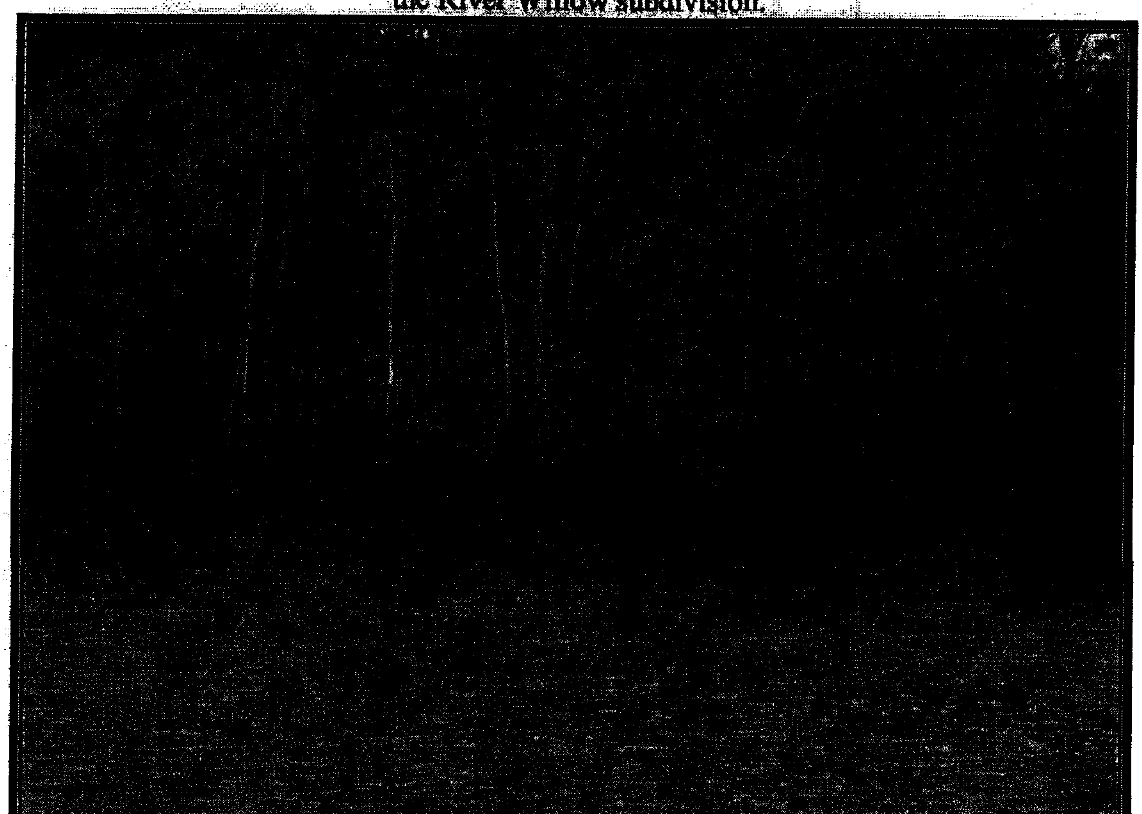
Looking northerly from the River Willow subdivision portion of the subject at the I-95 dam.



Looking at the typical property in the Willow River equestrian development in Hampton Falls



Facing southeasterly from the Towle Farm Road looking at the sloping shoreline of the River Willow subdivision.



Facing northerly from equestrian neighborhood looking at the Taylor River Estates properties and a typical shoreline home.

Looking southeasterly Taylor River Estuary salt marsh from the northbound rest area on I-95 as how the subject pond might look in the After Situation after the dam removal.

CERTIFICATE OF APPRAISER

I hereby certify:

That I have personally inspected the affected neighborhoods and that I have also made a personal field inspection of the comparable sales relied upon in making the paired set analysis. The subject is as represented by the photographs contained in this assignment.

That to the best of my knowledge and belief the statements contained in the assignment herein set forth are true, and the information upon which the opinions expressed therein are based is correct; subject to the limiting conditions therein set forth.

That I understand that this consultant assignment is to be used in connection with property that will be affected by the dam removal and subsequent draining of the Taylor River Pond by the State of New Hampshire.

That this assignment has been made in conformity with the appropriate State laws, regulations and policies and procedures applicable to appraisal of real property for such purposes.

That neither my employment nor my compensation for making this appraisal and report are in any way contingent upon the values reported herein.

That I have no direct or indirect present or contemplated future personal interest in such property or in any benefit from the disposal of such property appraised.

That I have not revealed the findings and results of such appraisal to anyone other than the property officials of the Department of Transportation of said State or officials of the Federal Highway Administration and I will not do so until so authorized by State officials, or until I am required to do so by due process of law, or until I am released by this obligation by having publicly testified as to such findings.

Barry Moore, MAI, the appraiser's supervisor assisted me in the inspections of the subject neighborhoods and the paired sets analysis.

That my opinion of the average market value loss on the pertinent waterfront properties as of the 7th day of April 2009, is **-20% on the Hampton waterfront properties, -10% on the Hampton common access waterfront properties** and **–5% on the Hampton Falls properties** based upon my independent analysis and the exercise of my professional judgment.

5/27/09
(Date)

James T. Minichiello
James T. Minichiello Staff Appraiser

General Assumptions And Limiting Conditions:

General Assumptions

- the section areas given to me have been properly calculated based on the available maps;
- information from all sources is reliable and correct unless otherwise stated.

Limiting Conditions

- There are no hidden or unapparent conditions along the various neighborhoods, in the subsoil (including hazardous waste or ground water contamination), that would render the sections more or less valuable. I assume no responsibility for any of these conditions or the engineering that may be required to discover or correct them. If any contamination is found on the subject, this report becomes null and void.
- Possession of this report (or a copy) does not carry with it the right of publication. It may not be used for any purpose other than by the party to whom it is addressed without the written consent of the State of New Hampshire and in any event only with the proper, written qualification and only in its entirety. Neither all nor any part of the contents (or copy) shall be conveyed to the public through advertising, public relations, news, sales, or any other media without written consent and approval of the State of New Hampshire.
- Acceptance and / or use of this report constitutes acceptance of the foregoing underlying limiting conditions and underlying assumptions.

Extraordinary Assumptions

- The value loss estimates herein are based on the waterfront properties that will be affected by the draining of Taylor River Pond.

MEMORANDUM

The Louis Berger Group, Inc. 1001 Elm Street, Suite 203, Manchester, NH 03101
Tel: (603) 644-5200   Fax: (603) 644-5220

To: L. Robert Landry, Project Manager

From: Craig Wood, PWS

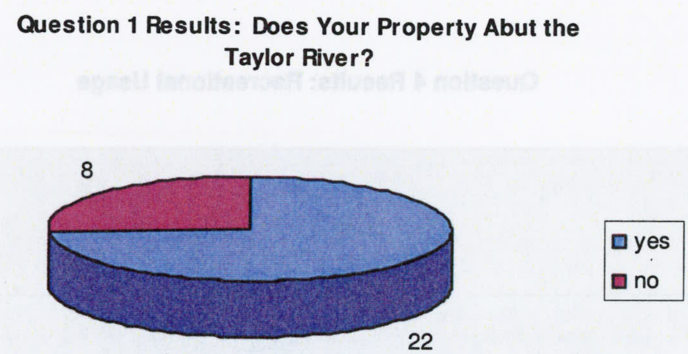
cc: Project Team

Date: November 21, 2006

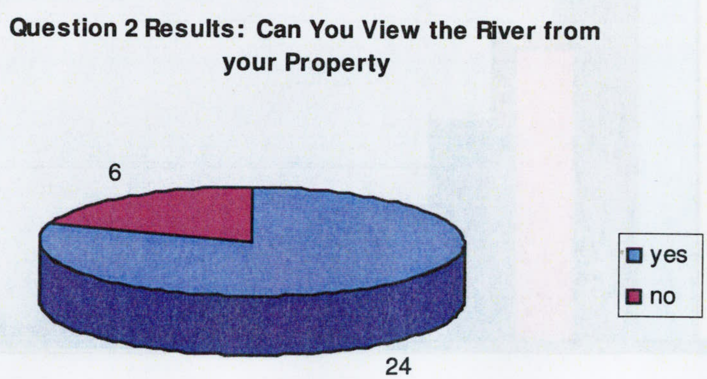
Re: Taylor River Recreational Questionnaire

On Saturday October 27th Chris Gajeski conducted the Taylor River Recreational Use Survey, targeting the direct abutters and neighborhoods within sight of the Taylor River impoundment. Of the approximately 55-60 residences visited, he was able to survey 30. The results of Recreational Use Survey are summarized below, as well as a copy of the blank questionnaire form.

1. Does your property abut Taylor River? Y / N



2. Can you view the River from your property? Y / N



MEMORANDUM

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3. If not an abutter, how did you travel to the River?

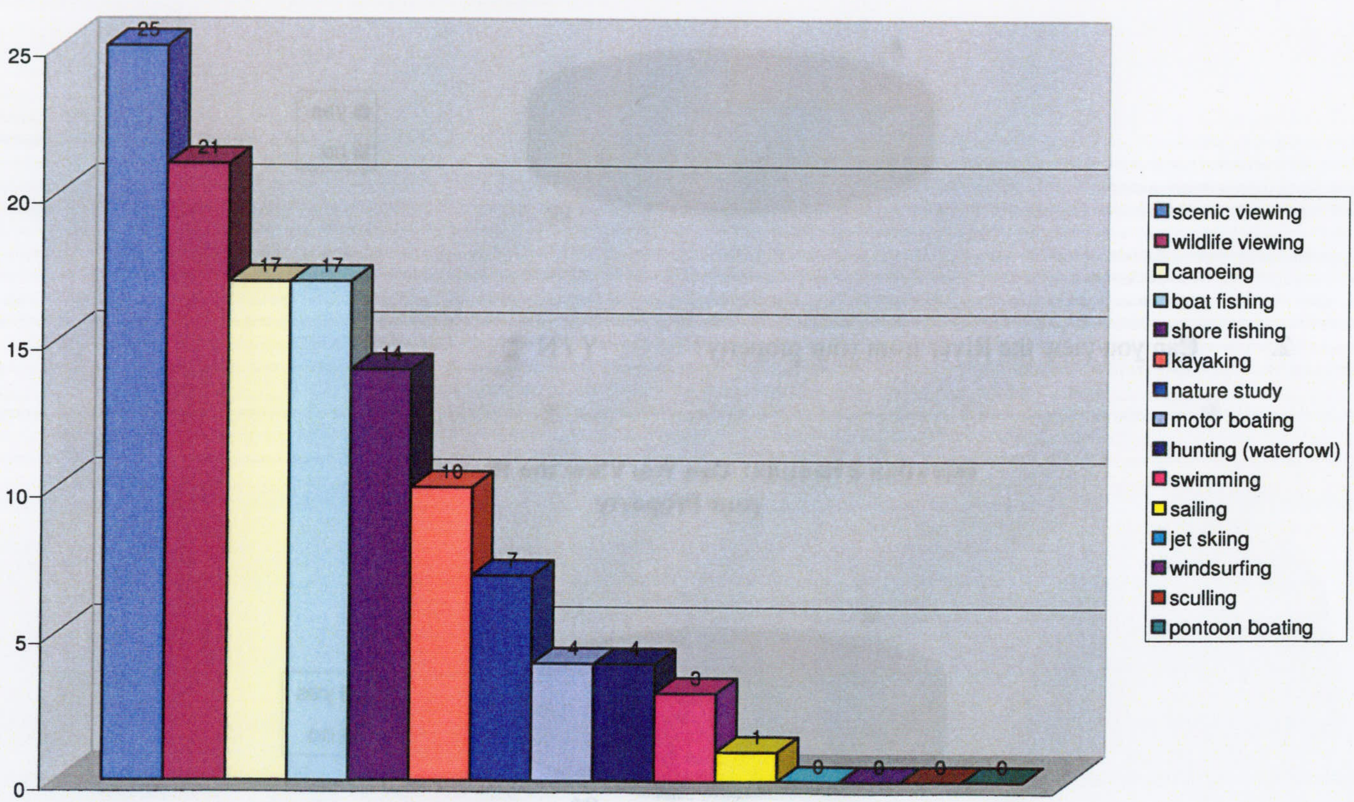
   No responses were received for this question.

4. Which recreational activities do you participate in on Taylor River?

☐ motor boating	☐ kayaking	☐ scenic viewing
☐ pontoon boating	☐ canoeing	☐ nature study
☐ jet skiing	☐ swimming	☐ wildlife viewing
☐ windsurfing	☐ sailing	☐ hunting (waterfowl)
☐ sculling	☐ boat fishing	☐ shore fishing

If other, please specify: ______________________________

Question 4 Results: Recreational Usage

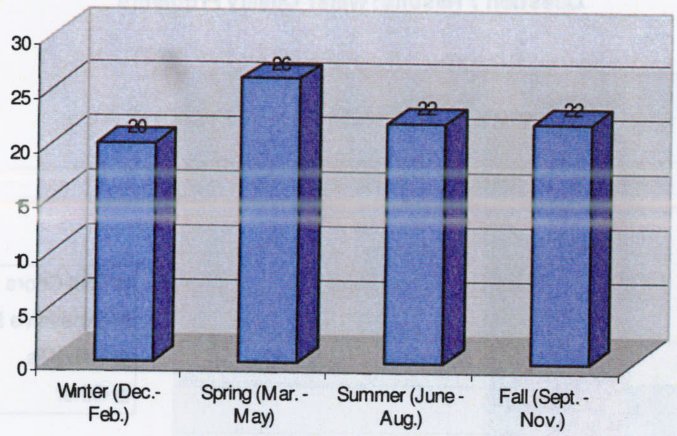


The Louis Berger Group, Inc. 1001 Elm Street, Suite 203, Manchester, NH 03101
Tel: (603) 644-5200 Fax: (603) 644-5220

5. How frequently do you participate in recreational activities on Taylor River (days per season)?

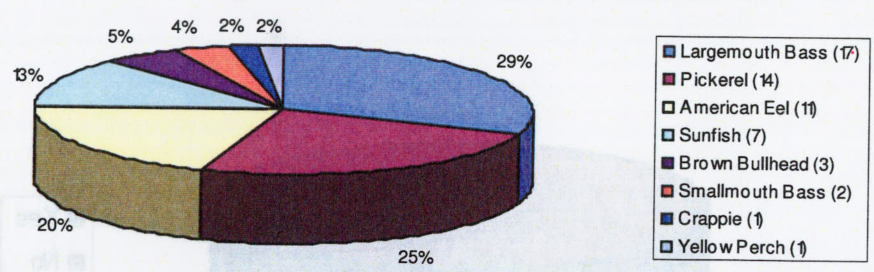
Winter (Dec.-Feb.) ___ Spring (March-May) ___ Summer (June-Aug.)___ Fall (Sept.-Nov.)___

Question 5 Results: Seasonal Participation



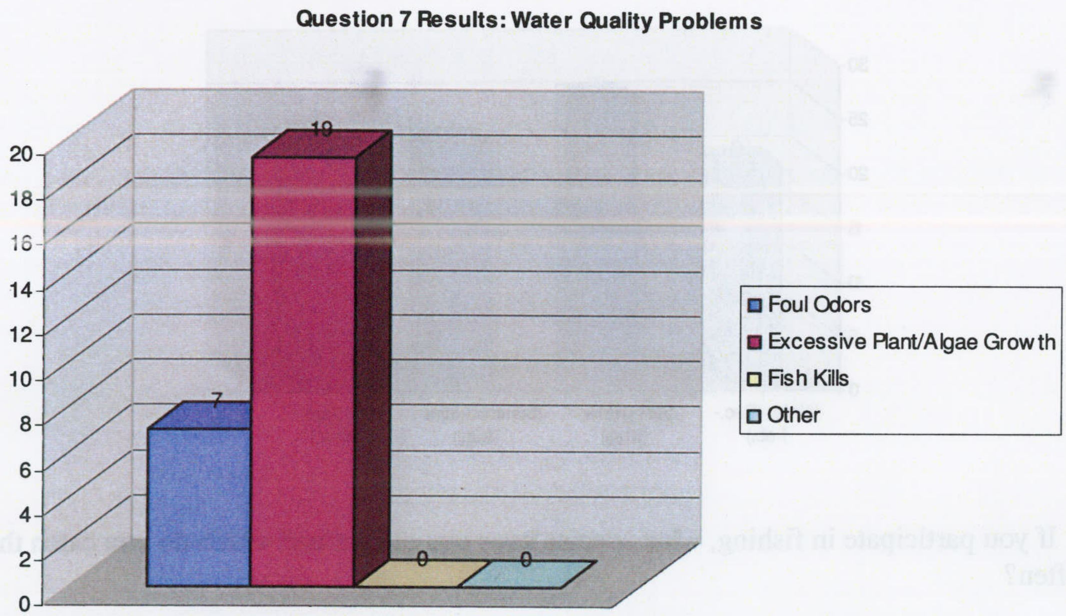
6. If you participate in fishing, what species have you caught and which do you catch the most often?

Question 6 Results: Fish Caught by Species

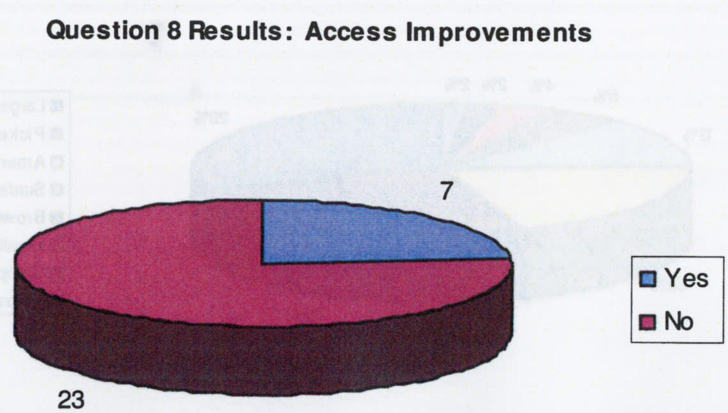


The Louis Berger Group, Inc. 1001 Elm Street, Suite 203, Manchester, NH 03101
Tel: (603) 644-5200 Fax: (603) 644-5220

7. Have you witnessed any water quality problems?
   - ☐ Foul Odors ☐ Fish Kills
   - ☐ Excessive Plant/Algae growth ☐ Other ____________________



8. Would you like better public access to the River? Y/N



MEMORANDUM

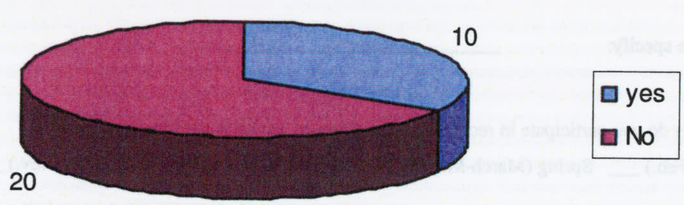
The Louis Berger Group, Inc. 1001 Elm Street, Suite 203, Manchester, NH 03101
Tel: (603) 644-5200 Fax: (603) 644-5220

9. If yes, what type of improvements would you like to see?

Responses were as follows: Boat Launch (3)
Algae/Vegetation Control (2)
Flood Control (2)
Access Improvement (1)
Scenic Area (1)
Clean Up (1)
Sandy Beach (1)

10. Have you experienced any problems with flooding? Y/N
If yes, when?

Question 10 Results: Flooding Experiences



The Louis Berger Group, Inc. 1001 Elm Street, Suite 203, Manchester, NH 03101
Tel: (603) 644-5200 Fax: (603) 644-5220

SURVEY FORM – Taylor River Recreational Questionnaire

Hello, my name is ____________ and I am conducting interviews as part of the Taylor River Feasibility Study being conducted by the NH Department of Transportation, in coordination with the NH Department of Environmental Services. The purpose of the study will be to determine a recommended action for the Taylor River restoration to include assessment for removal or replacement of the dam to accommodate fish passage and replacement of the I-95 Bridge over the Taylor River. This information will be used as part of the Feasibility Study and will aid in understanding more about recreational uses in the area. The questionnaire will only take a few minutes, and if desired, your responses will be kept confidential. Thank you for your time and input.

Date: ________________ Interviewer: ____________________ Time: ____________

Name: ______________________ Address: ____

1. Does your property abut Taylor River? Y N
2. Can you view the River from your property? Y/N
3. If not an abutter, how did you travel to the River?

   ☐ Walk ☐ Drive ☐ Other ____________

4. Which recreational activities do you participate in on Taylor River?

☐ motor boating	☐ kayaking	☐ scenic viewing
☐ pontoon boating	☐ canoeing	☐ nature study
☐ jet skiing	☐ swimming	☐ wildlife viewing
☐ windsurfing	☐ sailing	☐ hunting (waterfowl)
☐ sculling	☐ boat fishing	☐ shore fishing

   If other, please specify: ____________________

5. How frequently do you participate in recreational activities on Taylor River (days per season)?

   Winter (Dec.-Feb.) ___ Spring (March-May) ___ Summer (June-Aug.) ___ Fall (Sept.-Nov.) ___

6. If you participate in fishing, what species have you caught and which do you catch the most often?

   ____________ ____________ ____________ ____________
   ____________ ____________ ____________ ____________

7.. Have you witnessed any water quality problems?

   ☐ Foul Odors ☐ Fish Kills
   ☐ Excessive Plant/Algae growth ☐ Other ____________________

8. Would you like better public access to the River? Y/N
9. If yes, what type of improvements would you like to see? ________________________
10. Have you experienced any problems with flooding? Y/N

    If yes, when ____

Thank you for your assistance!

Memo

NH NATURAL HERITAGE BUREAU

To: Chris Gajeski, The Louis Berger Group Inc
1001 Elm Street Suite 204
Manchester NH 03101

From: Melissa Coppola, NH Natural Heritage Bureau
Date: 1/19/2007 (valid for one year from this date)
Re: Review by NH Natural Heritage Bureau
NHB File ID: 7137
Project type: Restoration feasibility study
cc: Kim Tuttle

Town: Hampton, Hampton Falls
Location: JI 1750: Taylor River

As requested, I have searched our database for records of rare species and exemplary natural communities, with the following results.

Comments:

Natural Community	State[1]	Federal	Notes
Brackish marsh	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.
High salt marsh	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.
Low salt marsh	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.
Saline/brackish intertidal flat	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.
Saline/brackish subtidal channel/bay bottom	--	--	Threats to these communities are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat) and increased input of nutrients and pollutants in storm runoff.

Memo

NH NATURAL HERITAGE BUREAU

Tidal creek bottom	--	--	Threats to these communities are primarily alterations to water level or flow regimes, and increased input of nutrients and pollutants in storm runoff.

Plant species	**State[1]**	**Federal**	**Notes**
Salt-loving Spike-rush (*Eleocharis uniglumis*)*	T	--	Threats are primarily alterations to the hydrology of the wetland, such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat, activities that eliminate plants, and increased input of nutrients and pollutants in storm runoff.
Salt-marsh Gerardia (*Agalinis maritima*)	T	--	A wildflower that grows in very shallow, briefly flooded forb pannes in the high salt marsh. Threats are primarily alterations to the hydrology of the wetland (such as ditching or tidal restrictions that might affect the sheet flow of tidal waters across the intertidal flat), activities that eliminate plants, and increased input of nutrients and pollutants in storm runoff.
Slender Blue Flag (*Iris prismatica*)	T	--	Since this plant grows at wetland edges (marshes, wet meadows, seashore), it would be threatened by changes in local water levels or shoreside development.
Yellow Thistle (*Cirsium horridulum*)	E	--	This species usually occurs on uplands adjacent to salt marshes and is threatened by habitat loss due to development.

Vertebrate species	**State[1]**	**Federal**	**Notes**
Banded Sunfish (*Enneacanthus obesus*)*	--	--	Contact the NH Fish & Game Dept (see below).
Saltmarsh Sharp-tailed Sparrow (*Ammodramus caudacutus*)	--	--	Contact the NH Fish & Game Dept (see below).
Willet (*Catoptrophorus semipalmatus*)	--	--	Contact the NH Fish & Game Dept (see below).

[1]Codes: "E" = Endangered, "T" = Threatened, "--" = an exemplary natural community, or a rare species tracked by NH Natural Heritage that has not yet been added to the official state list. An asterisk (*) indicates that the most recent report for that occurrence was more than 20 years ago.

Contact for all animal reviews: Kim Tuttle, NH F&G, (603) 271-6544.

A negative result (no record in our database) does not mean that a sensitive species is not present. Our data can only tell you of known occurrences, based on information gathered by qualified biologists and reported to our office. However, many areas have never been surveyed, or have only been surveyed for certain species. For some purposes, including legal requirements for state wetland permits, the fact that no species of concern are known to be present is sufficient. However, an on-site survey would provide better information on what species and communities are indeed present.

Department of Resources and Economic Development
Division of Forests and Lands
(603) 271-2214 fax: 271-6488

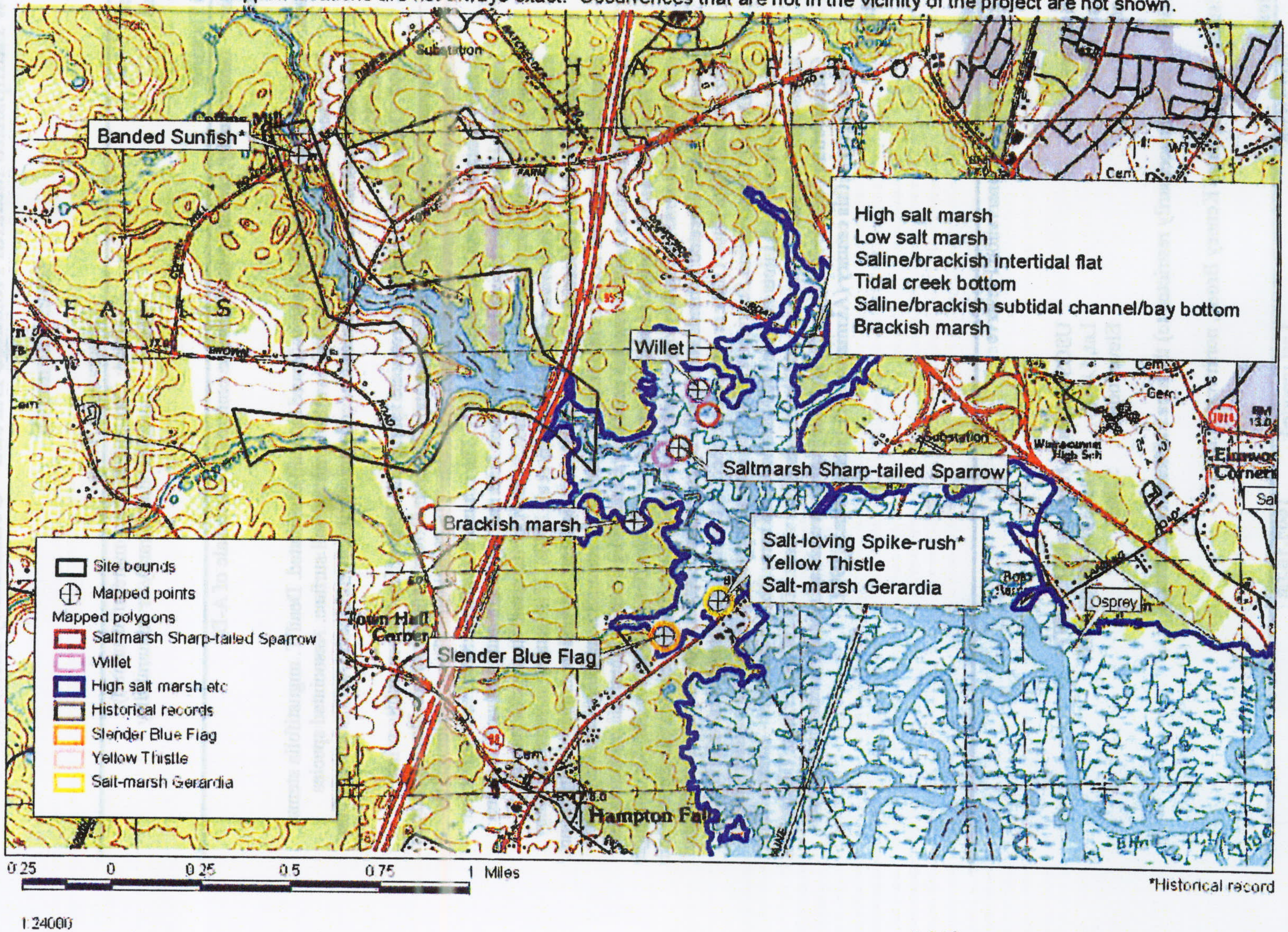
DRED/NHB
PO Box 1856
Concord NH 03302-1856

NHB: 7137

NH NATURAL HERITAGE BUREAU

Known locations of rare species and exemplary natural communities

Note: Mapped locations are not always exact. Occurrences that are not in the vicinity of the project are not shown.



*Historical record

Valid for one year from this date 19 Jan 2007

New Hampshire Natural Heritage Bureau - Community Record

Brackish marsh

Legal Status

Federal: Not listed
State: Not listed

Conservation Status

Global: Not ranked (need more information)
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and lanscape context ('B' on a scale of A-D).
Comments on Rank:

Detailed Description: 1997: *Typha angustifolia* (narrow-leaved cat-tail) dominated. Dead T. angustifolia stems from the previous year were thick above the hydrated soil surface. Associated species included *Spartina patens* (salt-meadow cord-grass) and several species with a cover of less than 1% each.

General Area: 1997: Occurred in a cove with restricted spring-tide "sheet flow" (bi-monthly or less frequent flooding event). The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Subtidal communities are ***tidal creek bottom*** and Undifferentiated ***saline/brackish subtidal channel/bay bottom***. Intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and high and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments:
Management Comments:

Comments: **Location**

Survey Site Name: Marsh Lane Conservation Preserve
Managed By:

County: Rockingham
Town(s): Hampton Falls
Size: 1.7 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425539N, 0705132W
Elevation: 5 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Estuary near mouth of Kenney Brook, northwest of Rte. 1.

Dates documented

First reported: 1997-10-08
Last reported: 1997-10-08

Nichols, Bill. 1997. Field survey to Hampton Salt Marsh on October 8.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

Brackish marsh

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and lanscape context ('B' on a scale of A-D).

Comments on Rank: Rank is for largest area visited (Taylor River). Others were B- (three sites) or C (Seabrook Salt Marsh).

Detailed Description: 1997: A characteristic mix of graminoids includes *Agrostis stolonifera* var. *palustris* (marsh creeping bent-grass), *Spartina patens* (salt-meadow cord-grass), *Juncus gerardii* (salt marsh rush), *Solidago sempervirens* (seaside goldenrod), *Distichlis spicata* (spike-grass), *Juncus arcticus* var. *littoralis* (shore rush), *Elytrigia repens* (quack-grass), *Spartina pectinata* (fresh-water cord-grass, slough-grass), *Carex paleacea* (chaffy salt sedge), *Hierochloe odorata* (sweet grass), *Aster novi-belgii* (New York aster), *Scirpus pungens* (three-square rush), and several other less frequent species. At the Seabrook School area, ephemeral runoff channel/stream entering from west; area dominated by *Lythrum salicaria* (purple loosestrife). Small elevated knoll in middle with *Quercus bicolor* (swamp white oak), *Toxicodendron radicans* (climbing poison ivy), and *Rosa virginiana* (Virginia rose).

General Area: 1997: The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Exemplary subtidal communities are ***tidal creek bottom*** and undifferentiated ***saline/brackish subtidal channel/bay bottom***. Exemplary intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and high and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments: 1997: Tidally flooded by salt water only during spring tides and storm surges. Supports a greater diversity of plants and generally flooded less frequently than the robust forb brackish marsh. Elevationally higher, received more freshwater input, and experienced less frequent tidal flooding than the high salt marsh. Occasionally occurs along the upper margins of the high salt marsh where sufficient fresh water runoff or groundwater discharge flows onto the marsh surface. This hydrologic regime supports brackish marsh species and other species most often found in fresh or salt marshes but tolerant of brackish conditions and able to successfully compete in this environment.

Management Comments:

Comments: Location

Survey Site Name: Hampton Harbor
Managed By: ASNH to Properties, Inc. - Pelton

County: Rockingham USGS quad(s): Hampton (4207087)

Town(s): Hampton **Lat, Long:** 425407N, 0704957W
Size: 4634.2 acres **Elevation:** 5 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. 1997: Five areas visited. Wrights Island (park at Seabrook Sewage Treatment Plant), Farm Brook (drive to east end of Depot Road and park in lot), two areas at Seabrook School Salt Marsh (park behind the Seabrook Elementary/Middle School off of Walton Road), and Taylor River (along the northern portions of the Taylor River Estuary from Drakes Creek to Tide Mill Creek).

Dates documented

First reported: 1997-07-05 **Last reported:** 1997-10-06

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

High salt marsh

Legal Status
Federal: Not listed
State: Not listed

Conservation Status
Global: Not ranked (need more information)
State: Rare or uncommon

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).
Comments on Rank: These ranks are for the entire estuary.

Detailed Description: 1997: In addition to *Spartina patens* (salt-meadow cord-grass) and *Juncus gerardii* (salt marsh rush), other common plants on the high marsh included smooth cord-grass (short form) and *Distichlis spicata* (spike-grass). D. spicata formed pure stands in wetter, more poorly drained areas, or mixed with S. patens, growing at similar elevations on the high marsh. J. gerardii dominated landward of salt meadow-grass in narrow vegetative zones with decreased tidal flooding and soil water salinity, beginning at about mean spring high water. This zone had the highest species richness within the high marsh and included *Solidago sempervirens* (seaside goldenrod), *Panicum virgatum* (switch-grass), *Hierochloe odorata* (sweet grass), *Carex hormathodes* (necklace sedge), *Festuca rubra* (red fescue), *Aster novi-belgii* (New York aster), *Elytrigia repens* (quack-grass), *Spartina pectinata* (fresh-water cord-grass), and *Potentilla anserina* (silverweed).

General Area: 1997: At Hampton Harbor, the mean tidal range is 8.3 feet with spring tides averaging 9.5 feet. Here, the high marsh rises from ca. 4 feet above mean sea level at its lower end to 5 feet above mean sea level at the landward limit of the salt marsh rush zone. The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Subtidal communities include the undifferentiated ***saline/brackish subtidal channel/bay bottom*** and ***tidal creek bottom***. Other intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments:

Management Comments: 1997: Marsh ditched heavily; greenhead boxes present.

Comments: Location

Survey Site Name: Hampton Harbor
Managed By: ASNH to Properties, Inc. - Pelton

County: Rockingham
Town(s): Hampton
Size: 4634.2 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425407N, 0704957W
Elevation: 4 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. Occurs behind barrier beaches, along inland bays, and other areas protected from high-energy wave action.

Dates documented

First reported: 1997-07-05 Last reported: 1997-10-08

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

Low salt marsh

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).
Comments on Rank: These ranks are for the entire estuary.

Detailed Description: 1997: No details.

General Area: 1997: The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Subtidal communities include the undifferentiated ***saline/brackish subtidal channel/bay bottom*** and ***tidal creek bottom***. Other intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and ***high salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments:

Management Comments:

Comments: Location

Survey Site Name: Hampton Harbor
Managed By: ASNH to Properties, Inc. - Pelton

County:	Rockingham	USGS quad(s):	Hampton (4207087)
Town(s):	Hampton	Lat, Long:	425407N, 0704957W
Size:	4634.2 acres	Elevation:	4 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. Occurs behind barrier beaches, along inland bays, and other areas protected from high-energy wave action.

Dates documented

First reported: 1997-07-05 Last reported: 1997-10-08

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

Saline/brackish intertidal flat

Legal Status
Federal: Not listed
State: Not listed

Conservation Status
Global: Not ranked (need more information)
State: Rare or uncommon

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).
Comments on Rank: Ranks are for an area at Seabrook School Salt Marsh.

Detailed Description: 1997: No details.

General Area: 1997: The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Subtidal communities include the undifferentiated ***saline/brackish subtidal channel/bay bottom*** and ***tidal creek bottom***. Other intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, and high and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuaryis unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments: 1997: Extensive areas of this community type were found within the Blackwater - Hampton River Estuary. Intertidal sand and mud flats are gently sloping, sparsely vegetated, habitats. The substrate, exposed completely at extra low spring tide, ranges in composition from sands to muds and silts. Benthic diatoms and other microalgae occurring in this environment are important contributors to the primary productivity of the total estuarine system (Sickley 1989). Macroalgae is typically uncommon across the exposed substrate. Characteristic invertebrates found in New Hampshire's intertidal mudflats include polychaete worms (including Nereis virens, Nephtys caeca, Clymenella tortquata, and Scoloplos spp.) and mollusks (including soft-shelled clam [Mya arenaria], Baltic Macoma [Macoma balthica], gem shell [Gemma gemma], and swamp Hydrobia [Hydrobia minuta]) (NAI 1973). Arthropods are also well represented and include green crabs (Carcinus maenus), rock crabs (Cancer irroratus), flat-clawed hermit crabs (Pagurus pollicaris), and horseshoe crabs (Limulus polyphemis). During the diurnal (twice daily) tidal flooding several species of fish and other aquatic species feed on the benthos and epibenthic algae. This community also provides important foraging habitat for shorebirds and other animals when the intertidal flat is exposed. The diverse variety of primary foods (microalgae, phytoplankton, and detritus) available to consumers supports the high productivity found on intertidal flats. The substrate is composed of sand or silt and clay rich in organic matter. Vascular plants are sparse to more typically absent.

Management Comments:

Comments: Location

Survey Site Name: Hampton Harbor
Managed By: ASNH to Properties, Inc. - Pelton

County: Rockingham
Town(s): Hampton
Size: 4634.2 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425407N, 0704957W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. Occurs between estuarine marshes or other coastal communities landward and subtidal communities seaward and includes tidal creek channels exposed at low tide.

Dates documented

First reported: 1997-07-05 Last reported: 1997-10-08

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

Saline/brackish subtidal channel/bay bottom

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).
Comments on Rank: Ranks are for an area at Seabrook School Salt Marsh.

Detailed Description: 1997: No details.

General Area: 1997: The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Another subtidal community is ***tidal creek bottom***. Intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and high and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments: 1997: These communities perform important ecological functions including supporting fish populations, providing refuge for fish and invertebrates that retreat from intertidal flats and estuarine marshes at low tide, and serving as a spawning and nursery area for numerous species of aquatic animals (Short 1992). Salinities in coastal areas remain close to 30 ppt year-round (Short 1992). Substrates varied at different locations and included mud, sand, gravel, cobble, or rock. Vascular plants were typically absent or sparse. Seaweeds are an important component of this habitat and the surrounding environment.

Management Comments:

Comments: Location

Survey Site Name: Hampton Harbor
Managed By: ASNH to Properties, Inc. - Pelton

County:	Rockingham	USGS quad(s):	Hampton (4207087)
Town(s):	Hampton	Lat, Long:	425407N, 0704957W
Size:	4634.2 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. Occurs in permanently flooded saline tidal channels and bays.

Dates documented

First reported:	1997-07-05	Last reported:	1997-10-08

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Community Record

Tidal creek bottom

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Not ranked (need more information)
State:	Not listed	State:	Rare or uncommon

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).

Comments on Rank: Ranks are for an area at Seabrook School Salt Marsh.

Detailed Description: 1997: The substrate was composed of mud rich in organic matter. Vascular plants were sparse but included *Ruppia maritima* (widgeon-grass).

General Area: 1997: The Blackwater - Hampton River Estuary contains the majority of the estimated 6200 acres of salt marsh in the state. The Blackwater River portion of the estuary continues south into Salisbury, MA. The estuarine system extends seaward to an imaginary line drawn across Hampton Harbor Inlet and upstream and landward to where ocean-derived salts are less than or equal to 0.5 parts per thousand during the period of average annual low freshwater flow (Cowardin et al. 1979). This estuary is surrounded by moderate levels of residential and commercial development. Several exemplary subtidal and intertidal communities occur in this estuary. Another subtidal community is the undifferentiated ***saline/brackish subtidal channel/bay bottom***. Intertidal communities are ***brackish marsh***, ***coastal shoreline strand/swale***, ***saline/brackish intertidal flat***, and high and ***low salt marsh***. Exemplary dry Appalachian oak-hickory forest occurs at the site as "salt marsh islands", forested uplands surrounded by salt marsh. Most of the estuary is unaffected by restricted tidal flow. Other areas are described as having an adequate tidal inlet by the USDA Soil Conservation Service (1994). The largest portions of the estuary determined to have inadequate tidal inlets include the Meadow Pond area, the Taylor River - Drakes River area west of the rail road track, and the Browns River west of the rail road track (USDA Soil Conservation Service 1994). In the last four years, several salt marsh restoration projects have begun in this estuary (Ammann, A.P. pers. comm., 1997).

General Comments: 1997: Tidal creeks provide habitat for stickleback (Pungitius pungitius, Gasterosteus aculeatus, and Apeltes quadracus), mummichog (Fundulus heteroclitus), and several other species of fish (Short 1992) and foraging ground for migratory and year round bird species and other animals. As the salt marsh replaces accreting intertidal flats seaward, tidal creeks develop along former intertidal flat drainage channels. Landward, as the high salt marsh develops above mean high water, tidal flooding frequency decreases, reducing drainage flow in the creeks. This tends to cause the upstream end of the tidal creek to fill in as sediment deposition occurs at a greater rate than erosion (Redfield 1972). The banks of tidal creeks were nearly vertical and often slump, supporting a narrow band of Spartina alterniflora (smooth cord-grass) (see low salt marsh description).

Management Comments:

Comments: **Location**

Survey Site Name: Hampton Harbor

Managed By: ASNH to Properties, Inc. - Pelton

County:	Rockingham	USGS quad(s):	Hampton (4207087)
Town(s):	Hampton	Lat, Long:	425407N, 0704957W
Size:	4634.2 acres	Elevation:	

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Large area more or less framed by Rte. 1 to the west, Rte. 101 to the north, Rte. 1A to the east, and the Massachusetts state line to the south. Occurs in permanently flooded creek-bottoms draining

water from the high and low salt marsh into the main channel or bay.

Dates documented

First reported: 1997-07-05 Last reported: 1997-10-08

Nichols, Bill. 1997. Field survey to Blackwater River Salt Marsh on July 5.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Plant Record

Salt-loving Spike-rush (*Eleocharis uniglumis*)

Legal Status
Federal: Not listed
State: Listed Threatened

Conservation Status
Global: Demonstrably widespread, abundant, and secure
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1989: NO PLANTS SEEN. 1983: 51-100 PLANTS IN 1 SMALL STAND. MOSTLY IN SHADE.
General Area: SALTMARSH PEAT AND MUD. ASSOCIATED SPECIES: *Spartina alterniflora*.
General Comments:
Management Comments:

Comments: Location

Survey Site Name: Taylor River Thistle Meadow
Managed By: Chase Lot

County: Rockingham
Town(s): Hampton Falls
Size: 2.8 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425527N, 0705115W
Elevation: 5 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: HAMPTON FALLS. TAYLOR RIVER THISTLE MEADOW. SIDE OF RTE 1 SALTMARSH BY KENNEY BROOK.

Dates documented

First reported: 1983
Last reported: 1983-09-22

Sperduto, Dan. 1989. Field survey to Taylor River Thistle Meadow of 18 August.

New Hampshire Natural Heritage Bureau - Plant Record

Salt-marsh Gerardia (*Agalinis maritima*)

Legal Status

Federal: Not listed
State: Listed Threatened

Conservation Status

Global: Demonstrably widespread, abundant, and secure
State: Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Not ranked
Comments on Rank: Sub-population of a large "A-" population.

Detailed Description: 1997: 51-100 fruiting ramets in a 1-5 square meter area.
General Area: 1997: Salt marsh. Associated plant species include *Triglochin maritimum* (arrow- grass), *Juncus gerardii* (salt marsh rush), and *Salicornia europaea* (common glasswort).
General Comments:
Management Comments:

Comments: Location

Survey Site Name: Kenney Brook
Managed By: Chase Lot

County: Rockingham
Town(s): Hampton Falls
Size: 2.8 acres
USGS quad(s): Hampton (4207087)
Lat, Long: 425527N, 0705115W
Elevation: 3 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: From Hampton Beach head northwest on Rte 101. Take Rte 1 south and park at Marsh Lane Conservation Preserve on the west side of Rte 1. Located near the confluence of Kenney Brook and the Taylor River.

Dates documented

First reported: 1997-09-12
Last reported: 1997-09-12

Nichols, Bill. 1997. Field survey to Hampton Salt Marsh on September 12.

Nichols, William F. 2000. Ecological Assessment of Selected Towns in New Hampshire's Coastal Zone. Prepared by NH Natural Heritage Inventory. Concord, NH.

New Hampshire Natural Heritage Bureau - Plant Record

Slender Blue Flag (*Iris prismatica*)

Legal Status		**Conservation Status**	
Federal:	Not listed	Global:	Apparently secure but with cause for concern
State:	Listed Threatened	State:	Imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Good quality, condition and lanscape context ('B' on a scale of A-D).
Comments on Rank: Invasion of shrub and other species.

Detailed Description: 2002: 15-20 normal plants counted. 20% in leaf, 40% in bud, 10% in flower, and 30% with immature fruit. 1989: 100-200 maturing capsules, 100-150 vegetative stems in 60-70 sq yd population area.1983: 101-1000 plants in fruit. 1982: >500 plants found in area 150 yards by 75 yards, most with maturing capsules.

General Area: 2002: Buckthorn thicket or Bitterweet/poison ivy patch. Associated plant species in immediate vicinity include: Buckthorn, *Viburnum recognitum*, *Acer rubrum* (red maple), poison ivy, goldenrod, and oriental bittersweet. Dominant species include arrowood, poison ivy, and also Japanese knotwood. Unknown date: Peaty meadow with *Vaccinium*, *Cirsium horridulum*, *Gaylussacia*. *Habenaria*. *Lacera* also found. Flat, open and wet.

General Comments: 2002: Next year check closer to the Taylor River Bridge. Date unknown: Area very interesting and presence of both *Cirsium* and *Iris* make it valuable. Population is declining.

Management Comments: 2002: Heavily threatened by invasive species. What was once a sunny, open, upland meadow is now either a buckthorn thicket, or a bittersweet/poison ivy patch. Only a few small areas still open for now.Unknown date: Serious threat to site exists due to invasion by shrubs and other species.

Comments: **Location**

Survey Site Name: Taylor River Thistle Meadow
Managed By: Chase Lot

County:	Rockingham	USGS quad(s):	Hampton (4207087)
Town(s):	Hampton Falls	Lat, Long:	425522N, 0705126W
Size:	2.8 acres	Elevation:	10 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: Hampton Falls. Taylor River Thistle Meadow. 1/8 mile south of river on west side of Rte 1.

Dates documented

First reported: 1982 Last reported: 2002-06-24

Raddatz, A., D. Lievens, P. Mullin, and N. Canvet. 2002. Field survey to Taylor River Thistle Meadow on June 24.

New Hampshire Natural Heritage Bureau - Plant Record

Yellow Thistle (*Cirsium horridulum*)

Legal Status		Conservation Status	
Federal:	Not listed	Global:	Demonstrably widespread, abundant, and secure
State:	Listed Endangered	State:	Critically imperiled due to rarity or vulnerability

Description at this Location

Conservation Rank: Excellent quality, condition and lanscape context ('A' on a scale of A-D).
Comments on Rank: WIDE-SPREAD, LARGE AREA.

Detailed Description: 1989: 150-200 PLANTS, 35 PERCENT DISPERSING SEED, 65 PERCENT BASAL LEAVES ONLY. 1982: >50 PLANTS SCATTERED OVER AN AREA CA. 50 BY 100 YARDS. MANY PLANTS ALREADY SET SEED, SOME FLOWERING OR IN BUD, SOME WITH ONLY BASAL LEAVES, NO FLOWERING STALKS. DUNLOP SPECIMEN AT NHA.

General Area: PEATY MEADOW, 0-10 FEET, FLAT, OPEN AND WET FIELD, ALSO CONTAINING VACCINIUM SPP., GAYLUSACCIA SPP., *Iris prismatica*, VIBERNUM RECOGNITUM.

General Comments: MOST SIGNIFICANT POPULATION FOR THE COASTAL ZONE. SEARCH GREATER AREA, MAY BE MORE PLANTS.

Management Comments:

Comments: Location

Survey Site Name: Taylor River Thistle Meadow
Managed By: Chase Lot

County:	Rockingham	USGS quad(s):	Hampton (4207087)
Town(s):	Hampton Falls	Lat, Long:	425527N, 0705115W
Size:	2.8 acres	Elevation:	10 feet

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: HAMPTON FALLS. TAYLOR RIVER THISTLE MEADOW, ONE-EIGHTH OF A MILE SOUTH OF THE RIVER ON WEST SIDE OF RTE 1. SCATTERED ABOVE HIGH TIDE DITCH IN OPEN AREAS BETWEEN RTE 1, KENNEY BROOK AND FIRST WEST ROAD SOUTH OF RIVER.

Dates documented

First reported:	1982	Last reported:	1989-08-18

Sperduto, Dan. 1989. Field survey to Taylor River Thistle Meadow of 18 August.

New Hampshire Natural Heritage Bureau - Animal Record

Banded Sunfish (*Enneacanthus obesus*)

Legal Status
Federal: Not listed
State: Not listed

Conservation Status
Global: Demonstrably widespread, abundant, and secure
State: Rare or uncommon

Description at this Location

Conservation Rank: Historical records only - current condition unknown.
Comments on Rank:

Detailed Description: 1985: 2 age and sex unknowns seen (Obs_id 389).
General Area: 1985: Freshwater - Stream or river (Obs_id 389).
General Comments: 1985: Two individual Banded Sunfish (42 and 69 mm. long) sampled by electrofishing at NHFG Fishing for the Future index site RO284028. Index site is 300 ft. long (Obs_id 389).

Management Comments:

Comments: Location

Survey Site Name: Taylor River, Coffins Mill
Managed By:

County: Rockingham
Town(s): Hampton
Size: .3 acres

USGS quad(s): Exeter (4207088)
Lat, Long: 425633N, 0705239W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions: 1985: Taylor River at Stagecoach Road [coordinates indicate a road labelled Coffins Mill Rd on the topographic map] (Obs_id 389).

Dates documented

First reported: 1985-09-26
Last reported: 1985-09-26

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 2 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Saltmarsh Sharp-tailed Sparrow (*Ammodramus caudacutus*)

Legal Status

Federal: Not listed
State: Not listed

Conservation Status

Global: Apparently secure but with cause for concern
State: Not ranked (need more information)

Description at this Location

Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2004: 2 nests, low nest density.
General Area:
General Comments:
Management Comments:

Comments: Location

Survey Site Name: Drakeside Road
Managed By: Town of Hampton Marsh - Mott

County: Rockingham
Town(s): Hampton
Size: 5.7 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425550N, 0705123W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented

First reported: 2004
Last reported: 2004

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 2 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.

New Hampshire Natural Heritage Bureau - Animal Record

Willet (*Catoptrophorus semipalmatus*)

Legal Status
Federal: Not listed
State: Not listed

Conservation Status
Global: Demonstrably widespread, abundant, and secure
State: Not ranked (need more information)

Description at this Location
Conservation Rank: Not ranked
Comments on Rank:

Detailed Description: 2004: Confirmed breeding, 3 nests.
General Area:
General Comments:
Management Comments:

Comments: Location
Survey Site Name: Drakeside Road
Managed By: Town of Hampton Marsh - Mott

County: Rockingham
Town(s): Hampton
Size: 3.8 acres

USGS quad(s): Hampton (4207087)
Lat, Long: 425558N, 0705119W
Elevation:

Precision: Within (but not necessarily restricted to) the area indicated on the map.

Directions:

Dates documented
First reported: 2004
Last reported: 2004

The New Hampshire Fish & Game Department has jurisdiction over rare wildlife in New Hampshire. Please contact them at 2 Hazen Drive, Concord, NH 03301 or at (603) 271-2461.